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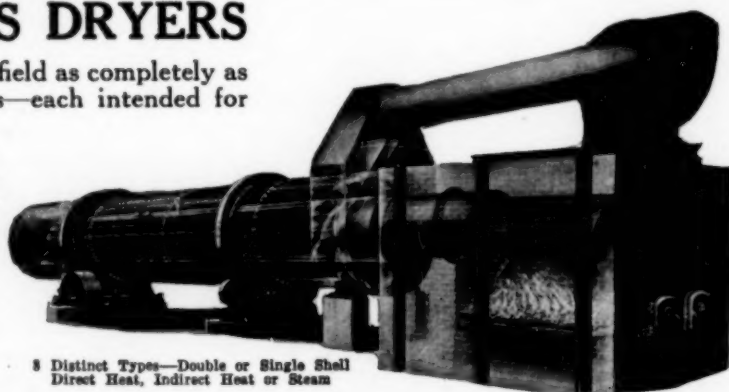
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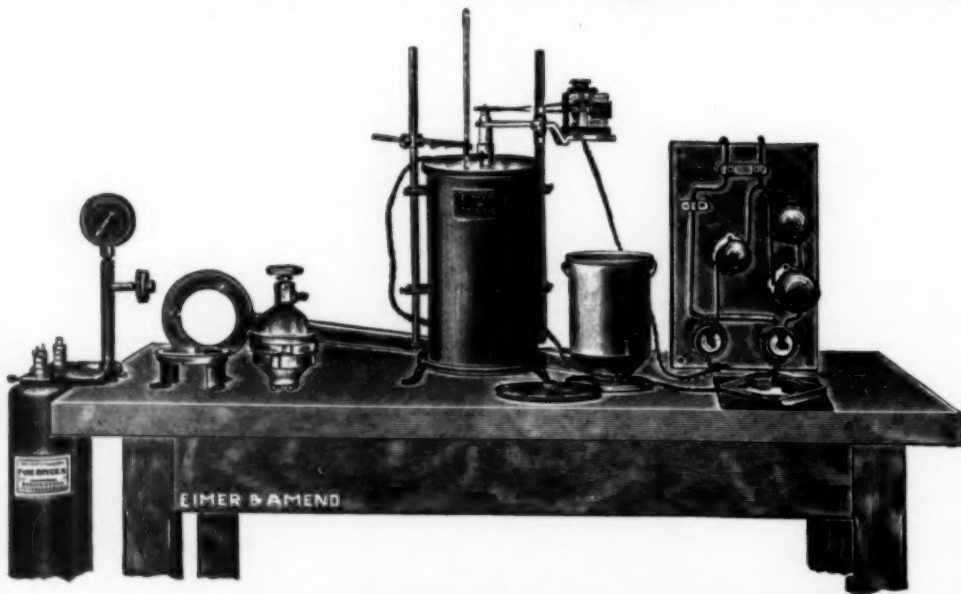
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Number 8

## Wisdom in Managing an Educational Institution

WHILE we continue to twit our California friends and to assure them that we have already heard of their far-famed climate, they seem to be doing things out there. In fact they have been doing things for several years. Some time ago in talking with one of the most illumined professors of chemistry in the country he expressed a desire to go to California and to visit Berkeley.

"Why?" we asked.

"I should like to observe how GILBERT LEWIS does it," he replied.

Now the school of chemistry at the University of California has so established itself that it needs no encomium from us; but here comes the announcement of the California Institute of Technology that Dr. ROBERT A. MILLIKAN, professor of physics at the University of Chicago, will go permanently to Pasadena to become director of the Norman Bridge Laboratory of Physics at the Institute and chairman of its Executive Council. The presidency of the Institute was offered to him, but—let us quote a few words of rare wisdom from a note on the subject in *Science* of August 12. "The trustees . . . were appreciative of his desire not to be burdened with the administrative duties usually attached to that office and have created a new administrative board to be called the Executive Council, which will combine the usual functions of the president and the executive committee of the board of trustees. It will consist of six members, three trustees and three members of the faculty, viz.: ROBERT A. MILLIKAN, chairman; ARTHUR H. FLEMING, president of the board of trustees; HENRY M. ROBINSON, first vice-president of the board (and president of the First National Bank of Los Angeles); GEORGE E. HALE, director of the Mt. Wilson Observatory; ARTHUR A. NOYES, director of the Gates Chemical Laboratory, and EDWARD C. BARRETT, secretary of the Institute."

How rare, and how sweet to the scientific ear it is to hear that the trustees themselves were mindful of the fact that a great teacher does not want to be burdened with administrative duties! And how reasonable it is, in an establishment that has no ambition to be big in the number of its students, to secure the advantage of his wisdom along with that of Dr. HALE and Dr. NOYES in conjunction with the president, the first vice-president and the secretary of the board to order the affairs of an institute of science!

Liberal provision has been made for the prosecution of research and a joint attack is to be made from the physical and chemical laboratories on "the most fundamental problem of physical science today: that of the constitution of matter and its relation to the phenomena of radiation."

In addition to the advantage of the occasional presence of Professor A. A. MICHELSON of Chicago, Professor H. A. LORENTZ of Leyden will be in residence as lecturer and research associate during two months of the coming winter and Dr. C. G. DARWIN of the University of Cambridge has been appointed professor of mathematical physics for the college year of 1922-23.

We do not want to appear before our readers as too radical or as iconoclastic. We recognize the value of traditions and the merit of maintaining them. But given a student with a mind open to mathematics and an unspoiled curiosity in regard to the unseen causes of things, we venture the opinion that there is more in it for him, somehow, to study among selected students with these masters of science than there would be if he were captain of a football team that is champion of the Pacific Coast, the Rocky Mountains, the Middle West and the Atlantic Seaboard all at once. There is more in it for him than there would be in making the Harvard Crimson fade away to a pale pink, the Yale Blue look almost white and in reducing the Princeton Tiger to a maltese cat on all the fields of sport. Shocking as this may sound, we venture to say it right here, in the open, on the irrevocable printed page.

Now bring along your University Clubs!

## The Long, Long Road to Results

*ARS longa, vita brevis est.* And long, too, are the ways of industry, which is itself an application of the arts. We children of men are crude, very crude, and it takes generations to do what we know should be done and wish to see done. If we look at a railway locomotive with a scientific conscience, we recognize immediately that it is a wretched thief of the heritage of future generations in its voracious wastefulness. A blast furnace is also as much of a destructor as it is a producer. And why should we transport coal on expensive railroads, then on still more expensive trucks, then on trucks again only to get a little of the available energy out of it while we waste the precious lower hydrocarbons that it contains?

We know better but somehow we don't get around to it. On every side we see things done as they should not be done; but the inertia of tradition and the lack of competent leaders inhibit progress. Look at our methods of transporting freight by rail. For example, A wants to deliver to B, who lives a hundred miles away, two tons of a product which he makes. There are no standard containers, everybody uses what he can get. A 5-ton truck carries the two tons of merchandise to the freight shed. There it waits until a car comes along that is going in B's direction

or destined to the place where B wants the goods. Not once in ten thousand times is it possible to put it on the car with the mechanical economy provided by cranes and platform cars. Usually it is banged about by a lot of roustabouts and with innumerable strains and shouts it is shoved through the narrow door of a box car. Stevedore work is required after it is in the car. When the car is wholly or partly filled it is shunted off to wait a convenient train and then it is shunted on again. Arrived at its destination, there is more straining and grunting to get it out of the door, on a platform and under cover. B then receives a postal card that his goods have arrived and he sends a 5-ton truck that may not have to wait more than five or six hours and then it takes more grunts and strains to load it up and to unload it after the truck arrives at his place of business. The time is likely to be a week or ten days for shipment and nobody knows how many men have been banging it about with hooks and eating up its value with time-and-a-half or double for overtime.

Adequate terminals with cranes overhead depositing each parcel of freight from above on a flat car already part of a predestined train, and tarpaulin covers when needed, would take care of the loading and unloading in a small fraction of the time and expense now required. The railroads themselves or a single co-ordinated trucking concern could gather up and deliver freight with a fraction of the expense now involved. Why don't we do these things? Why are we so slow in making advances? The answer is very simple. We lack the men in place to see improvements through.

In many respects the world is bobbing around like a chicken with its head cut off simply because of a lack of leaders.

### Mechanical Engineering In Chemical Production

TWO of the articles in this issue have been contributed by mechanical engineers. Although this in itself is not an unusual occurrence, it serves to emphasize the close relations existing between the different branches of the engineering profession. The chemical engineer must rely upon his older brother for much of the mechanics of chemical production. He must be able to draw from the other divisions of engineering as much of their specialized knowledge and experience as will serve to assist him in solving his problems. He must in turn contribute his own experience and expert advice so that all may derive benefit from the common fund of knowledge.

CHRISTIAN KRARUP, who gives us the article on potash recovery, is a mechanical engineer confronted with the thoroughly practical problem of putting the cement mill's byproduct industry on a paying basis. The cement dust must be separated from the volatilized salts as early as possible in the operation or else difficulties arise which prevent the proper application of the fundamental principle of the process. The raw material dust causes trouble for the electrical engineer in charge of the precipitation chamber and later on the separation of the gypsum from the mixture of dust and potash tests the skill of the chemist and chemical engineer. The problem was solved, however, by a combination of simple mechanical operations. Water sprays, which are used to cool the gases before they pass to the electrical

treater, were used to remove the bulk of the dust, and the remainder was separated by gravity precipitation. This simple modification of the process meant the difference between success and failure for the byproduct installation.

The second article is by THOMAS G. ESTEP. He deals with a problem of interest to the operating engineer who is concerned with the measurement of gases. He tells us that engineers are often apt to overlook the necessity for correcting their gas measurements for the water vapor contained in the saturated gases, even though large errors can thus be introduced into their determinations. In most cases the correction for the vapor is greater than the error due either to observation or to the accuracy of the measuring device. All of these devices, such as Pitot tubes, Venturi meters, orifices and throttle disks, measure the gases in terms of velocity as indicated by a measurable differential pressure. To calculate the volume of the gas from its velocity, however, requires a determination of density, and herein lies the difficulty. Since the gas is a mixture of gas and water vapor, either an accurate analytical determination is necessary or the operator must resort to a laborious mathematical process. Professor ESTEP, recognizing the delay that the tedious calculations and physical measurements usually involve, has prepared a set of curves which will materially assist in the calculation where a gas saturated with water vapor is being measured. Knowing the temperature and pressure of the gas at the point of measurement and the specific gravity of the dry gas, the specific gravity of the saturated gas can be read directly from the curves. This value can then be subtracted in the usual velocity formula, from which the volume of the gas can readily be calculated. The procedure for partly saturated gases is also simplified by these graphical determinations.

The mechanical problems referred to in these articles are similar to many which are met in chemical production, and therefore they lie distinctly within the field of chemical engineering. If the chemical engineer is to serve his industry to the fullest extent, he will do well to profit by the experiences of workers in other branches of the engineering profession.

### Athletics And Chemistry

IT IS not our habit to discuss or to record intercollegiate or international sports, or sport of any kind except the queen of them all, which is the hunt for knowledge in science. But at the international meet in New York in July there was a sequel to an event which seems interesting from the standpoint of chemistry. The contestants in the one-mile run were STALLARD of Cambridge, IRISH of Cornell, MCCULLOCH of Princeton and KENT-HUGHES of Oxford. Our interest is in the first named. He's a tall, lank Englishman, or looks like one, wherever he hails from. He saved his wind without falling behind until they had covered about three-quarters of the course and then with all his might and all his strength forged ahead and won the race by a considerable lead. He conserved his powers until they were needed and then he put everything he had into it.

Of course, there is nothing remarkable in that; every good athlete tries to do it, but it is pleasing to observe.

At about this time the captain of the Oxford-Cam-

bridge team came and took place beside a neighbor during some events in which he was not entered. "That STALLARD is a rum fellow," said he. "He is quiet and rather shy, but good company when you can get him. He has, however, a passion for chemistry, and you can't get him away from his chemistry books. On the way over he would take his exercise and then go back to them all the time. He spent from eight to ten hours a day at them, reading them with gusto like a boy with 'The Three Musketeers.' He lives in chemistry all the time."

This reminded us that Sir ERNEST RUTHERFORD is in Cambridge and so is Sir WILLIAM POPE, and other teachers of great repute and worth; that they have sound traditions in science and mathematics at that university, and that it might be worth while to make note of the name of the athletic student of chemistry: S-T-A-L-L-A-R-D.

### Steadier Prices

#### Mean Business Expansion

THERE can be no doubt that the volume of business transacted will increase as a result of the fairly stable basis the commodity markets have reached, whereas last winter everyone was insisting that business was halted while men waited for prices to decline. It does not follow, of course, that business will resume the swing it appeared to have in 1920. The showing of that year was partly fictitious. Since we lack comprehensive statistics of the volume of business transacted from time to time, we naturally fall back on symptoms, particularly prices. We have since found that in the case of many commodities the high prices ruling in 1920 did not really prove that there was a heavy demand, and the stocks that represented frozen credits toward the close of the year showed that in some instances the supply had been really in excess of the demand, the holders having contrived to conceal the fact. We may indeed reach a stage in the near future of doing a larger volume of business than was done in 1920, while the outrageous prices of that year certainly will not be developed.

The volume of business that is being done now is larger than is commonly assumed. The last report of ton-mileage freight movement on the railroads, for the month of May, shows an increase over the rate in April, and a rate slightly in excess of the rate in the best railroad year before the war, that being the year ended June 30, 1913. The Federal Reserve Board reports that debits to individual accounts at banks in the week ended June 1 were only 17 per cent less than in the corresponding week of 1920, while the week ended June 22 showed a lag behind 1920 of only 14 per cent. These showings are quite different from the common appraisals of the volume of business being done. The reaction to them should be that new light is being thrown on the situation, not that they are things to be explained away. They are plainly of fundamental importance.

Reverting to the statement that commodity prices are now much steadier, the Bureau of Labor Statistics at Washington released its wholesale price statement for July on August 18. This showed an index number (1913 = 100) of 148 for July, the same as had been shown for June. Farm products and "food, etc." increased two points each from June to July, while the other items, which are not weighted as heavily in the total, declined various numbers of points.

The readjustment is either completed for the time being or has reached its final stages, indicated by the fact that no longer are all prices declining. Early in the readjustment a common feeling was that if commodity A had experienced a great decline or had approached its pre-war price, and commodity B had had only a small decline or was still far above its pre-war level, then it was up to commodity B to do a great deal more and it was necessary to wait for the slacker to do his duty. Dr. HURLIN's statistics, commented on in these columns under date of July 27, 1921 (page 135) showed that commodity prices in general declined for about thirty years after 1815 and after 1865. The point is that some commodities can get down easily while others have a hard time of it. The divergences now in advances over 1913 averages shown by different commodities are due largely to that fact. The prices that are high have to be accepted as likely to decline but little from month to month. A basis for doing business is afforded.

Price divergences now are due largely to differences in the character of the costs. Some high costs were shaken out readily. Others yield grudgingly. Such increases in costs as are due to freight rates have not been shaken out at all, for freight rates have not been reduced. We cannot take a fixed relation to 1913 prices and say that each commodity must conform to that relation or be left alone until it does. Indeed, the entire process of deflation may be stopped altogether, for there are some able economists who now argue that we are likely to have a "secondary inflation" for a time.

### A Silk Purse

#### From a Sow's Ear

A FEATURE of the exhibit of Arthur D. Little, Inc., at the coming National Exposition of Chemical Industries, is a silk purse made out of a sow's ear. This hardly belongs to industry in the commercial sense, but it is at once an object lesson and a contribution to philosophy. First there was the sow which "passed on" as the saying is—but into provisions here present in accordance with her genus rather than into the less definitely known Great Beyond. The ears, instead of going into pickle, went into glue and the glue was softened in water, brought almost to the point of precipitation with acetone, then forced through a warm container into a spinneret and through this into a hardening solution of formaldehyde and acetone in a V-tube. It was picked out of the V-tube, reeled, dried, treated to a 40 per cent glycerine bath in which it was also dyed, then reeled and dried again, woven and sewed up—and there is as handsome a silk purse as ever was carried by the gentle abbess of whom CHAUCER sings and who never messed up her wineglass while engaged in the conviviality which now, alas, is denied to us.

As a chemical achievement it was play, mere play; an incident of minor research. Our interest in it is as a contribution to philosophy. This trinket, of which the silk is not even strong or of especially good quality, should serve as a mighty club in argument. The wretched old saw, "You can't make a silk purse out of a sow's ear," has been echoed down the ages, the Bourbon chortle of those who never learn and never forget. Let's hope that it may serve to refute the footless arguments of the ignorant and that it will help to lay those hoary ghosts of the past that jabber against progress. Science can do.

## Readers' Views and Comments

### Case Hardening and Oxidation of Steel

To the Editor of Chemical & Metallurgical Engineering

SIR:—Many events have prevented me from paying the necessary attention to the important paper by Mr. Matsubara on "Chemical Equilibrium Between Iron, Carbon and Oxygen" read before the February meeting of the American Institute of Mining and Metallurgical Engineers and briefly abstracted in your journal Feb. 23, 1921, page 331. I intend to study very carefully the data contained in this paper, and expect to resume my experimental researches in this very interesting field within a few months.

But in the meantime I must say that many points, both in the experimental part and in Mr. Matsubara's conclusions, seem worthy of a closer analysis, and—in some respects—to be open to some criticism.

His reaction chamber consisted of a glazed porcelain tube partly inclosed in an electric furnace, but whose ends projected into the open air. One end, in fact, was water-cooled. After introducing a certain amount of oxide, evacuating and bringing the furnace to the correct temperature, the gas to be charged was forced into the reaction chamber. After the reaction had proceeded "to equilibrium" the gas was drawn off and analyzed.

I will limit my observations to but two of the many points which could be discussed in connection with this experimental work. Mr. Matsubara does not sufficiently explain his manner of deducing equilibrium data in a vessel which is only partly heated to the reaction temperature to be studied and the balance (about one-quarter of its length) cooled by circulating water. Neither do I find any reference to the time required to withdraw the gas contained in the reaction chamber—which gas cannot be in a true physical and chemical equilibrium for the reason stated above.

These points and the many others that could be quoted perhaps have not been explained by the author for the sake of brevity. But in my opinion they require a complete discussion if the experimental results are to be taken as a sure basis of a new theory in open opposition to the results of previous investigators.

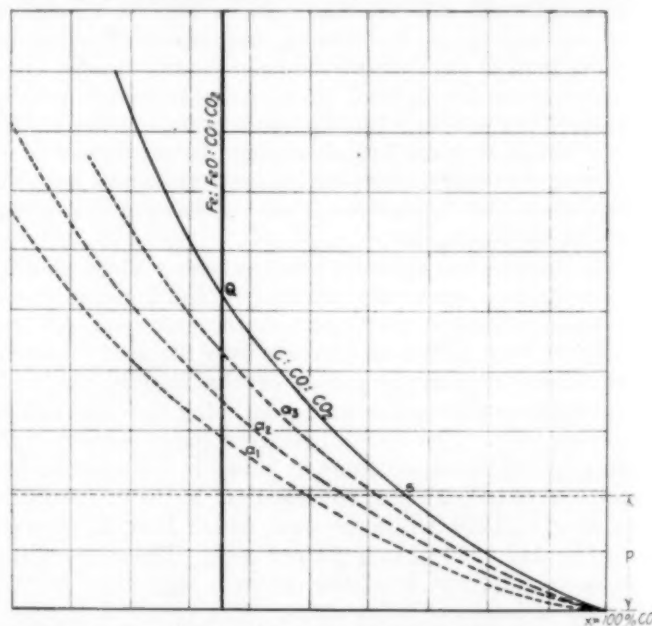
In any case, I am absolutely sure that the results of my experiments on the simultaneous oxidation and carbonization of iron by the system  $C:CO:CO_2$  under sufficient pressure cannot be explained in the way suggested by Mr. Matsubara—namely, that the oxidation may have been caused by an excess of  $CO_2$  being blown into the mass at too high velocity and reaching the metal before being converted by the hot surrounding charcoal into  $CO$ . I am fortified in this belief by the knowledge of many hundreds of carbonizations carried out under atmospheric pressure, but in all other respects under exactly identical conditions as those under higher pressure, not one of which has caused the slightest oxidation of the surface of steel imbedded in the charcoal. Neither did an increase in gas velocity twenty times higher cause any oxidation at atmospheric pressure.

Such simultaneous carbonization and oxidation I explained (and for that matter, still explain) on the basis of Schenck's investigations, easily summarized in

the attached diagram showing isothermals for the two systems in question. If conditions are as here represented, it is obvious that at some pressure  $p$ , less than  $Q$ , hot carbon will tend to hold the  $CO$  concentration at  $S$ , which will not only protect any iron from the formation of  $FeO$  but bring the carbon in austenite up through various stages represented by curves  $a_1, a_2, a_3$ , etc., eventually arriving at a certain carbon concentration ( $\Sigma$  austenite) which is in equilibrium with the same  $CO$  concentration as that generated by carbon. On the other hand, any pressure greater than that represented by  $Q$  will cause simultaneous oxidation and carbonization.

Mr. Matsubara's diagram shows the iron oxide vertical displaced far to the left so that the two principal curves do not intersect. Therefore his diagram infers that the admitted phenomenon of combined oxidation and carbonization must accomplish itself alternately in two opposite directions. Thus for some time the  $CO:CO_2$  mixture which bathes the surface of the iron would act as a carbonizing agent, but could not cause the least oxidation. In the next period of time the  $CO:CO_2$  mixture—having in some unexplained manner changed its composition—should act as an oxidizing agent.

Accepting for the moment this situation, it must be clear that in the second period of time the gas, containing a higher percentage of  $CO_2$ , cannot be in equilibrium



ISOTHERMALS SHOWING CONDITIONS EXISTING DURING CARBURIZATION BY  $CO$  AND CHARCOAL UNDER PRESSURE

with the carbonized zone produced previously. Necessarily, then, there must be some decarbonization of the outer layers of metal before the oxidation could occur. Such an intermittent process, no matter what the order or number of the alternate periods, would consequently leave an end product which is quite different from those I have observed without exception in pressure carbonizations.

In my own experience the finished samples always

possessed a thick layer, strongly and very uniformly carbonized, in which the carbon content reached its maximum value at the outer surface where the metal was in intimate contact with a thick solid crust of iron oxide. In this crust many pieces of charcoal were imbedded, so that the oxide was in close contact with free carbon, a proof that in my experimental conditions the gas mixture was in equilibrium at the same identical time with charcoal, iron oxide and the austenite of highest carbon content.

Aside from all these remarks, it must be constantly borne in mind that it has been experimentally proved, independently of any theory by Schenck or other scientist, that at certain temperatures the simultaneous carbonization and oxidation of iron can take place only when the pressure of the C:CO:CO<sub>2</sub> system exceeds a given value. Hence it follows with the same degree of certainty that the curves corresponding to the two reactions must cross each other at that pressure.

Turin, Italy.

FEDERICO GIOLITTI.

### Slip Interference Theory of Hardening

To the Editor of Chemical & Metallurgical Engineering

SIR:—Dr. Jeffries and Mr. Archer must be congratulated on their very interesting and important contribution to the theory of hardening published in your issue for June 15, 1921. The authors have in "slip interference" found a lucky word, which when made comprehensive enough gives a nice and easily remembered explanation of the cause of hardness, especially after defining hardness as resistance to deformation (or slip). If their theory is correct, it should satisfactorily explain all phenomena connected with hardening, and it may be of interest to discuss a few points to see whether the theory will hold when considered from a few other angles.

The authors state in the beginning that metals owe their hardness and strength to interatomic bonds and, further on, that deformation is caused by slip. I cannot find it clearly so stated, but it must be assumed that such slip will occur between atoms and will take place most easily at right angles to the direction where the sum of interatomic bonds is the least.<sup>1</sup> When some outside force is applied which causes slip between the atoms, these take up new positions, each to each, with stronger bonds. They can then better resist an outside force against further displacement. When the temperature is low and the molecular motion is not lively enough, no rearrangement of disorganized atoms will take place and the phenomenon known as cold-working is the result. When the outside force exceeds a certain limit, the interatomic bonds will be broken.

It is generally conceded, as the authors state on page 1059, that a solid solution will be harder or more resistant to slip than the pure solvent. Anybody who has watched the steel melter forging test samples taken from a furnace bath before and after the addition of a small amount of chromium will know that the sample containing chromium will yield less under the same hammer blow. The interatomic bonds when chromium is present in the hot alloy must evidently be stronger than when chromium free. The question may be asked whether this is caused by a network of Cr atoms in a lattice independent of the lattice of Fe atoms and possibly of a different orientation, or whether there are

distinct bonds between Fe and Cr in one lattice in which Cr atoms have replaced Fe atoms.

To my mind, diffusion at high temperatures and in the molten state is readily explained by assuming the solute to be distributed in the molecular state, and there is good reason to believe that cementite dissolves in that way when taken up by iron. This is denied by Jeffries and Archer. When solids dissolve in liquids like water or alcohol, the solution is molecular. Association or disassociation of molecules may occur according to circumstances. When carbon separates from solution in gamma iron, it is in the form of cementite. Furthermore, hydrocarbons are formed when quenched steels are dissolved in acid. Cementite can apparently migrate even below the critical range, since it is known that the cementite particles of sorbite or granular pearlite decrease in number and increase in size, and that even lamellar pearlite can be converted into granular by prolonged heating at 650 deg. C. These are reasons for assuming that cementite dissolves as such and is not dissociated into carbon and iron. It would be interesting to know in detail the author's reasons for not assuming cementite to dissolve as molecules in  $\gamma$  iron.

Jeffries and Bain have found that cold  $\gamma$  iron has a face-centered lattice and that  $\alpha$  iron has a body-centered lattice. In this they are in accord with Dr. Westgren.<sup>2</sup> Dr. Westgren has not yet been able to determine the space lattice for Fe<sub>3</sub>C at elevated temperature and whether there is any change in space lattice when dissolving in  $\gamma$  iron.<sup>3</sup> It would be most interesting if someone could succeed in doing this, because it might give an idea as to the form of cementite in  $\gamma$  iron. Most probably the space lattice of a crystalline solvent will have a directional influence on the space lattice of a crystalline solute, at least when the latter has some similar atoms, so that in the same crystal  $\gamma$  iron and cementite will have space lattices of the same general nature. The bonds between atoms in dissolved molecules will be stronger than between atoms in the solvent, thus the mass is made harder.

Like Dr. Westgren, they find that martensite consists mainly of alpha iron, which is in agreement with other known facts, but there is still the possibility that some  $\gamma$  iron is left in quantities insufficient to give interference lines in their photograms.

From remarks and the illustrations on page 1062 it appears that Jeffries and Archer consider it necessary that Fe<sub>3</sub>C particles must have reached a relatively large critical size, greater than a molecule, to give greatest hardness to the steel. They state, on the other hand, on page 1065, quoting evidence, that cementite cannot be detected in martensite and, further on, that carbon must be in solution. If cementite should act as keys on cleavage planes in the way the authors apparently explain it, the cementite must have separated out of solution but might still exist as submicroscopic agglomerates of Fe<sub>3</sub>C molecules.

The investigation of Andrews, Rippon, and Mills<sup>4</sup> shows clearly that cementite has not separated from

<sup>3</sup> Editor's Note: In a paper read before the British Iron and Steel Institute, May, 1921, meeting, Dr. Westgren gave results on hot and cold iron wires as follows:

Condition	Crystal Form	Length of Edge in Angstroms
Pure iron at room temperature.	Body-centered cube	2.83
Pure iron at 815 deg. C. (beta)	Body-centered cube	2.92
Pure iron at 1,090 deg. C. (gamma)	Face-centered cube	3.60
Cold 25 per cent nickel steel	Face-centered cube	3.58
Cold 12 per cent manganese steel	Face-centered cube	3.61

<sup>2</sup> *Jernkonteret Annaler*, 1920.

<sup>4</sup> *J. Iron and Steel Inst.*, 1920, p. 548.

<sup>1</sup> Compare the cleavage in graphite.

martensite as such. Andrews shows also that there is an increase in volume of  $\gamma$  iron when  $\text{Fe}_3\text{C}$  goes into solution; further, that a dissociation of carbide molecules is probable in steels with higher carbon contents when heated to high temperatures. The carbide expansion found by Andrews is nearly equal to the increase in volume of martensite over annealed steel. Austenite, on the other hand, has a smaller specific volume, and we know that cold-worked steel has a larger volume than annealed steel. It seems to the writer that these facts, to which the authors have made no mention, are of importance in determining the condition of the carbon in heat-treated steel.

It would be interesting to know whether there is not some slight change of volume in the aging and in the annealing of duralumin.

The increase in volume of a cold-worked steel is evidently due to slips having taken place. Now when  $\gamma$

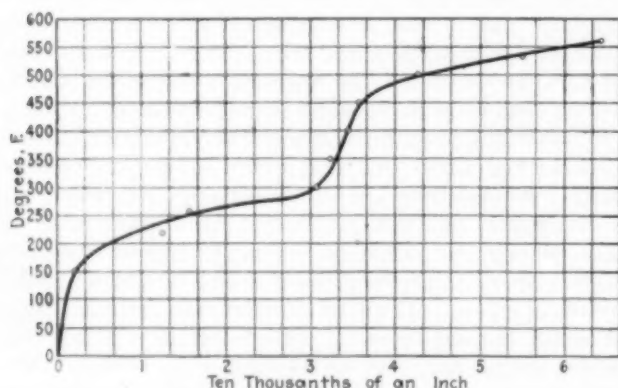


FIG. 1. DECREASE IN DIAMETER OF HARDENED STEEL BALLS WITH INCREASING DRAWING TEMPERATURES

iron transforms into  $\alpha$  iron an increase in volume also takes place, but the transformation in cooling does not take place instantaneously throughout the whole mass. Crystallization of  $\alpha$  iron starts on cleavage planes and grain boundaries of the  $\gamma$  grain and the first  $\alpha$  iron formed will tend to rid itself of the cementite present, but like in any other rapid crystallization, it succeeds but imperfectly. At the same time the volume changes attending transformation will cause mechanical work to be done on the surrounding metal, causing slippage and further increase in volume.

Gradual change in carbon content of martensite needles is easily seen by etching, especially in highly drawn nickel steels.

Portevin<sup>5</sup> showed that martensite forms below 300 deg. C. and that it takes time to form. An experience similar to the aging of duralumin can be cited. When hacksaw blades are hardened they can be straightened and set when they are no cooler than 100 deg. C. immediately after being withdrawn from the quenching bath, but if they have been cooled to room temperature and reheated 100 deg. C. or more, they cannot be straightened. Thus there is evidently some internal slipping going on in the steel immediately after quenching.

Andrews shows that on drawing hardened steels there is a cementite separation with decrease in volume at about 100 to 150 deg. C. and a transformation of  $\gamma$  to  $\alpha$  iron at about 400 deg. (shown by change in electric and magnetic resistance), but with a further decrease in volume which must be explained by healing the slip

planes and closing of voids. The attached curve (Fig. 1) made by Mr. Wright of the Atlas Ball Works, showing decrease in diameter of hardened balls by drawing to different temperatures, may be of interest in this connection. We have also found that simple storage at room temperature for a considerable time is sufficient to decrease a ball-diameter measurably. Andrews' investigation seems to indicate the presence of a small amount of  $\gamma$  iron even after hardening straight carbon steel, where he (Andrews) does not believe it is present, and Dr. Westgren also believes that his photograms show presence of  $\gamma$  iron in hardened steel.

Is it not reasonable therefore to conclude that in hardened steel, cementite is in solution in the traces of gamma iron left after most of the  $\alpha$  iron has formed. The  $\text{Fe}_3\text{C}$  molecules are still in solution, perhaps polymerized, and, with the  $\gamma$  iron, forming a kind of gel in the iron, but not separated as crystals of cementite. In such form the dissolved cementite molecules may well be considered as keys on the slippage planes of the iron.

Portevin showed that troostite forms at about 600 deg. C. and it is agreed that free cementite is then separated.

It seems clear that the crystallization power of ferrite and cementite, influenced in turn by the presence of other solutes in iron, will have some influence on the final product.

When martensite is formed from solid solution there is doubtless a grain refinement due to the formation of

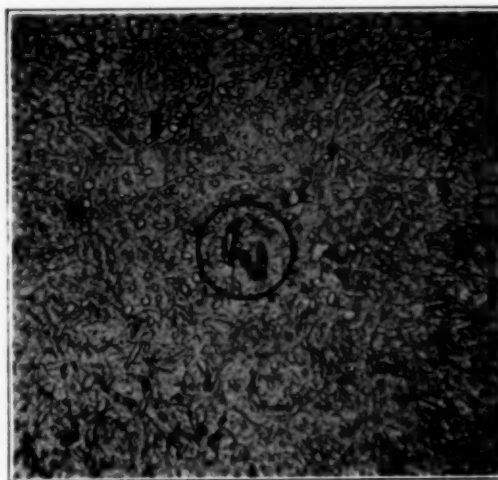


FIG. 2. SECONDARY FERRITE IN CHROMIUM STEEL.  $\times 1,000$ .

the many new particles of  $\alpha$  iron, but it should not be concluded directly that the hardness of the mass will be in inverse proportion to the size of such particles (which latter probably will have some relation to the size of the  $\gamma$  grain from which they are formed). McCance<sup>6</sup> shows little variation in Brinell hardness by increasing the quenching temperature, even though a coarser martensite is thereby produced.

How would the theory of Jeffries and Archer explain the formation of Hultgren's secondary ferrite in tungsten steel<sup>7</sup> and a similar phenomenon illustrated in Fig. 2 found sometimes in chromium steel? How would they explain the presence of internal stresses in hardened steels?

HAARON STYRI.

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<sup>5</sup>J. Iron and Steel Inst., 1914.

<sup>7</sup>Hultgren, "A Metallographic Study of Tungsten Steels," p. 14.

## Italian Chemical Industries

FROM OUR SPECIAL CORRESPONDENT

GENOA, Italy, Aug. 1, 1921.

**J**ULY was characterized by the return of orders on the Italian market, brought more through the fear of future increase in price, caused by a higher foreign exchange, than through the weak industrial demand. Such orders were principally for the commoner products and brought up prices of these, but they did not stop a further fall in price in the case of other products, despite the higher importation taxes arranged, the full force of which was felt the first of the month.

### NEW IMPORTATION TARIFFS ON CHEMICALS

The new importation tariffs are as follows: Silicate of soda and silicate of potash, in solution, 10 lire gold per ton; silicate of soda, solid, 25 lire gold; hypochlorite of potash and hypochlorite of soda, 40 lire gold; hypochlorite of lime, 20 lire gold; bicarbonate of soda, 30 lire gold; beet-root ashes, exempted; vegetable ashes, exempted; crystallized carbonate of soda, 10 lire gold; calcined carbonate of soda, 30 lire gold; carbonate of potash, 20 lire gold; carbonate of lead, 80 lire gold; carbonate of ammonia, 120 lire gold; carbonate of barium, 40 lire gold; carbonate of magnesia, 25 lire gold; ammonia, compressed, 120 lire gold; ammonia in solution, 50 lire gold; solid caustic soda, 30 lire gold; liquid caustic soda, 20 lire gold; caustic potash, 30 lire gold.

### REDUCTIONS IN IMPORTATIONS

The first four months of this year saw quite a general reduction in importations and exportations. The following were the values of some of the imported commodities: Benzine, 11,000,000 lire; petroleum, 12,000,000 lire; carbonate of soda, 13,000,000 lire; paraffine, 15,000,000 lire; explosives, 11,000,000 lire. The values of some of the exported products were: Citrate of lime, 30,000,000 lire; citric acid, 10,000,000 lire; sulphur, 15,000,000 lire; raw tartar, 7,000,000 lire; sumac, 7,000,000 lire.

### SUGAR IMPORTATIONS

In the year 1920 the sugar importations reached only 11,374 tons in the case of the finer product, against 73,465 tons in 1919 and 29,713 tons in 1918; and only 1 ton in 1920 in the case of the second class product. The total importation of the first class sugar can be subdivided as follows: United States, 6,635 tons; Japan, 430 tons; Egypt, 326 tons; Argentina, 11 tons; Brazil, 241 tons; Cuba, 179 tons; Dutch East Indies, 1,575 tons; France, 1,523 tons.

### HYDRO-ELECTRIC DEVELOPMENT IN ITALY

Italy developed with great energy its hydro-electric plants during the time of the war to meet as far as possible the demand for combustibles of all sorts, and at the end of 1915 as many as 329 plants were at work, with a total capacity of 835,000 hp. After 1915 fifty-eight other plants were constructed, producing additional 217,000 hp., and at present fifty-seven new plants, representing more than 599,000 hp., are under construction. For this reason Italy will soon have hydro-electric plants capable of producing about one million and a half horsepower. Fifty-nine mountain lakes will soon be completed for the above plants, having a capacity of 225,000,000 cu.m. Of these, seven have a total capacity of 10,000,000 to 40,000,000 cu.m. In addition

seventeen other reservoirs with a capacity of 701,000,000 cu.m. are now under construction. Among them is the enormous Tirso reservoir in the Isle of Sardinia, which will have a capacity when finished of more than 400,000,000 cu.m.

### PRODUCTION, IMPORTATION AND EXPORTATION OF SUPERPHOSPHATES

The production of bone superphosphates was greatly reduced through the war, falling from 924,736 tons in 1914 to 911,190 tons in 1915, 867,690 tons in 1916, 489,000 tons in 1917 and 480,000 tons in 1918. The importation also showed a marked decrease, being reduced from 38,249 tons in 1914 to 13,765 tons in 1915, 2,040 tons in 1916, ceasing altogether in 1917, and again reaching only 164 tons in 1918 and little more in 1919. In 1920 the total imports of all fertilizers reached 5,353 tons (leaving out Thomas slag). The exportations of bone superphosphates were 19,981 tons in 1914, 12,925 tons in 1915, 4,482 tons in 1916, 895 tons in 1917 and 6 tons in 1918, being stopped altogether after this. In 1914, 943,004 tons of bone superphosphates were available for agricultural purposes as against 912,030 tons in 1915, 865,248 tons in 1916, 488,105 tons in 1917 and 480,158 tons in 1918.

Up to the end of 1918 no production of mineral superphosphates was recorded. The importation was 513,998 tons in 1914, 456,901 tons in 1915, 434,713 tons in 1916, 230,150 tons in 1917 and 231,679 tons in 1918. The exportations of mineral superphosphates reached 8,560 tons in 1914, 1,805 tons in 1916, being stopped after this altogether. The mineral superphosphates in stock were 505,429 tons in 1914, 455,096 tons in 1915, 434,712 tons in 1916, 230,159 tons in 1917, and 231,078 tons in 1918.

These great reductions in the available stock of superphosphates impoverished the Italian soil, and production was reduced considerably and has not yet reached the proportions realized before the war.

### ESSENTIAL OILS AND CAMPHOR IN ITALY

Italy exports yearly about 30,000,000 lire of essence of flowers and aromatic plants. Among the essences produced in largest quantity is that of the flowers of the lavender plant, of which several million kilos are prepared yearly, and the price has risen during ten years from 20 to 150 lire per kilo. The essence of mint, which is produced in Piedmont and to a larger extent in the provinces of Turin and Cuneo, where the plant can be cultivated with a very high yield on account of the special nature of the ground, is exported to France and to England. Thyme oil has so far been produced principally in Sardinia, and more than 100,000 kilos of essence or oil of bergamot (which is largely employed in the preparation of eau de cologne) is produced, especially in the province of Reggio Calabria. The essences of rosemary, of anis, of orange flowers, etc., are also produced, but so far not in very large quantities.

Italy is in a position to produce natural camphor, as the camphor laurel is cultivated fairly easily at Naples and thereabout, at Caserta, at Rome, at Pisa, at Florence, on the Riviera and on Lake Maggiore. For the extraction of the camphor the green and dry leaves and the small branches of camphor laurel are employed. The yield in these portions of the plant is more than the yield of any foreign plant, but the yield in the roots, branches and trunk of the Italian laurel is much below that of foreign plants, especially the Japanese variety.

## The Successful Recovery of Potash as a Byproduct From Cement Kilns

Difficulties Encountered in Placing Byproduct Industry on a Paying Financial Basis and a Description of a Successful Plant in Which the Cement Dust Is Separated From the Potash by Spray Washers Prior to the Electrical Precipitation

By CHRISTIAN KRARUP

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THE comparatively small quantity of potassium salts volatilized from the raw material in rotary cement kilns and subsequently discharged into the atmosphere with the dust in the waste gases, suddenly came into prominence at the time the recent war cut off the usual supplies of this valuable material. The recovery of potash from the waste gases was undertaken by several cement companies throughout the United States, but in view of the fact that many of these attempts have met with failure, it is believed that the following account of a successful plant will be of interest. Rather than to give a detailed description of the plant, however, which admittedly may be considerably simplified and improved upon, it is the purpose of this article to point out the various problems encountered and to state the line of reasoning and the assumptions forming the basis for the design of the plant. It is believed that the information it is intended to convey will in that form be made more useful as an aid in the design and construction of future plants.

The quantity of potash available for collection varies at the different plants according to the raw materials used in the manufacture of the cement. It is stated that the average quantity volatilized at the plants in the United States is somewhat in excess of 2 lb. of actual potash ( $K_2O$ ) per barrel of cement manufactured, although at several plants as much as 4 lb. is volatilized. The recovered salts, consisting mostly of potassium sulphate, with some sodium sulphate, have been used principally as an ingredient in mixed fertilizers, but as these are made up according to definite specifications, the low and irregular potash content in the recovered product makes it somewhat undesirable for this purpose. Valuable as potash is as a fertilizer, it has, of course, no value whatever as a commodity unless placed on the market in a satisfactory commercial form. To realize better financial returns from the recovered potash, several companies therefore undertook to refine the product by leaching the salt from the dust and evaporating the solution to obtain the salt in a concentrated form. This process, however, had considerable trouble and expense attached to it and also resulted in some loss of potash, which made still more pertinent the question as to whether the industry would be able to survive at all, should the price of potash fall to the pre-war level.

### GYPSUM CAUSES DIFFICULTIES

That such a simple refining process should present any unusual difficulties may not be immediately apparent to the reader, but the elimination of gypsum has proved to be a serious stumbling block in connection with the recovery of potash from cement kilns. Many schemes, proposed and tried, would in practice have

worked perfectly, if gypsum had not the apparent habit of always crystallizing out where it is not wanted. The gypsum is formed in abundance, because an excess of  $SO_2$ , over that required to form potassium sulphate and sodium sulphate, is generally present in the gases, and if this excess has not all been combined with the lime in the dust to form gypsum, that remaining may be relied upon to expend itself in corroding metals or doing some other equal damage. Aside from the fact that to remove gypsum from the interior of pumps, pipe lines and filters involves considerable expense, the main objectionable feature in connection with gypsum is that it will combine with the potassium sulphate to form a "double salt," which is soluble only in very dilute solution. To separate any appreciable portion of this salt from the dust, it is necessary to use a large quantity of wash water, and this in turn increases the evaporation cost. Under certain conditions a very considerable portion of the potash is tied up in the dust in the form of this double salt and is therefore lost, unless it can be returned to the kiln to be re-volatilized. However, this procedure invariably results in a portion of the salt being crowded into the cement clinker or lost through other channels.

These are the principal reasons why the potash byproduct industry in connection with cement manufacture did not materialize as rapidly as might have been expected. The difficulties met with in connection with gypsum, no doubt, directly or indirectly, are responsible for the fact that the recovery has been abandoned by several companies that were already established in the business. The nature of the difficulties are such that no remedy apparently is possible as long as water is used in the process of separating the salt from the dust and on the other hand, no other course would seem to be left open, once the two are collected together in the mixed condition.

### CLASSIFICATION OF DUST AND FUME PARTICLES

Obviously the aim should be to collect each separately, as far as it is possible to do so. The dust and the salt are both present in the gases in the form of minute particles in suspension and are already apparently hopelessly mixed before leaving the kiln, but as the individual particles do not touch one another while in suspension in the gas, it is still possible, if the proper means are employed, to effect a classification of the particles before the collection is made.

It is, of course, essential that this classification should be carried out while the particles are still in suspension, because, if they are collected first and therefore brought in actual contact with one another, no mechanical means are then available for separating them to a

sufficient degree to permit a proper classification being made. This may be explained as being due to the fact that the power of cohesion, and that of adhesion as well, of particles of such extreme fineness is much greater than the weight of the particles themselves, which condition makes it impractical by mechanical means to dislodge individual particles, after they have attached themselves to other particles or objects.

It is of course necessary that the means employed for classifying the particles should recognize the difference in the physical characteristics of the dust and the salt. As the specific gravity of both substances is nearly the same, a difference in the size of the particles must be relied upon to accomplish the desired results. That there is a decided difference in the size of the dust and salt fume particles can readily be detected in a strong light, even with the naked eye. Individual dust particles may be distinguished floating in the gas, while individual fume particles cannot be singled out in the same manner, and their presence can only be recognized by the foggy appearance of the gas.

This difference in their physical characteristics is not surprising, when it is remembered how each is produced. The salt, being volatilized in the kiln, passes through the vapor state, in which condition it becomes diffused into a large quantity of gas; this vapor is condensed into a fog consisting of minute particles of salt in the liquid state, which subsequently change to the solid state, as soon as the temperature becomes low enough. Particles produced in that manner should naturally be expected to be very much smaller in size than the raw material dust particles, which have been produced by a grinding process.

The salt fog behaves very much like the ordinary fog, produced by water vapor in the atmosphere, which does not exhibit any tendency to settle due to the force of gravity, or at least, if such a tendency is present, it is so small as to be negligible; nor do the individual particles of their own accord tend to agglomerate to form bodies of such size that would be expected to settle. The dust on the other hand, it has been found, is acted upon sufficiently by the force of gravity to cause it to precipitate, if it is given the proper opportunity.

#### DETERMINING THE METHOD OF CLASSIFYING

It is not within the scope of this article to discuss the nature of the forces that cause the fume to act in a manner similar to that of a vapor, although it is composed of solid particles instead, but it is the purpose to bring out clearly that a difference between the dust and the fume does actually exist. While the fume will not settle appreciably by the force of gravity, it will, on the other hand, not stay indefinitely suspended in the gas, but must eventually precipitate upon any surface with which the gas is brought in contact. It is possible to carry out the classification in such a manner that practically no dust will be carried over into the salt, but it is not possible to prevent a certain quantity of the salt from being precipitated with the dust, because the dust particles originating in that part of the kiln where the potash salt is volatilized are surrounded by the salt vapor while suspended in the gas and some of this vapor is condensed upon the dust particles as a nucleus and is therefore firmly attached thereto.

The quantity of salt thus adhering to the dust is probably further increased in amount by the collection of solid fume particles on the surface. As the salt collected with the dust can not be made available for the

market except by bringing it into solution or by returning it to the kiln to be re-volatilized, it is desirable that the quantity, thus caught with the dust, should be held at a minimum. For that reason, the dust should be removed from the gas at the earliest possible moment, and it is necessary to use discrimination in the selection of the method to be used for the purpose.

The method employed must be efficient enough to prevent any large quantity of the dust from being carried over into the salt, and yet, at the same time, not precipitate an excessive amount of the salt into the dust. A solution to this problem has been successfully worked out at the plant of the Santa Cruz Portland Cement Co. at Davenport, California. This company is operating a potash-recovery plant that is of a high efficiency and simple in operation. A high grade product is recovered, containing about 33 per cent of  $K_2O$  as potassium sulphate, and the recovered salt is remarkably uniform in quality, seldom varying more than 1 or 2 per cent in its potash content. Each kiln is provided with a separate recovery unit and 10 such units are at present in operation. The daily production of potassium salts is 10 to 12 tons.

#### SEPARATING THE DUST BEFORE RECOVERING THE SALTS

For the recovery of the salts, the gases are first cooled with water sprays, which also incidentally remove the greater part of the dust; the portion not removed in that manner is then subjected to gravity precipitation and finally the salts are collected by electrical precipitation. The dust precipitated by gravity is returned to the kiln, but that caught by the sprays and therefore contained in water in the form of a thin slurry is conveyed by gravity to a Dorr thickener, where the solids are settled to the bottom and drawn off as a thick slurry. This slurry is filtered on Oliver continuous filters and the cake formed by this operation is dried in a rotary drier. The dried cake or dust is returned to the kiln along with the regular feed of raw material, of which it forms a part. The benefit derived from the return of this dust to the kiln is due partly to its value as raw material, but mostly to the fact that it contains a much higher percentage of potash than the original raw material. The quantity of dust collected in 24 hr. per kiln is about 6 tons and in this dust is the salt which is unavoidably caught along with the dust. This amounts to about 15 per cent of all that is volatilized. The clear liquor from the Dorr thickener is re-circulated through the sprays by a single stage centrifugal pump, which supplies a pressure of about 30 lb. per sq.in. at the spray nozzles.

As the chief interest in the recovery process is centered in the treatment of the gases for the collection of the salts, a detailed description of the auxiliary equipment is not attempted, inasmuch as this part of the plant has no direct bearing upon the results obtained in the recovery of the salts.

The recovery plant was originally designed for the recovery of the salts by the wet process and was operated successfully as such up to the latter part of the year 1919, at which time it was remodeled to meet the requirements for the collection of the dry salts direct from the gases. In remodeling the plant, many desired features in connection with the dry process have not as yet been applied. It is contemplated to eliminate the expense connected with the filtering and drying process by feeding the thick slurry from the Dorr thickener direct to the individual kilns. In no case, however, have

these deficiencies interfered with the proper application of the fundamental principle of the process, which had already been recognized and incorporated in the original installation, namely: "that of separating the raw material dust from the gases before the collection for the salts is made."

#### COOLING THE GASES

As the dry process of cement manufacture is in use at the Santa Cruz plant, the temperature of the waste gases is high, being about 750 deg. C. This makes it imperative to cool the gases as the first operation, because such a high temperature could not be handled through the recovery plant, on account of the deteriorating effect on the structures, which are of reinforced concrete and steel. It is also advantageous to cool the gases to a low temperature, as it greatly improves the efficiency of collection in the electrical treater.

Water sprays are used to cool the gases. As it is not desired to put the salt fume into solution, the spraying is limited to such an amount as will not completely saturate the gas with water vapor. The temperature may safely be lowered to 100 deg. C., which leaves a sufficient margin over the saturation temperature to insure that the salt fume will remain in the dry state in which it left the kiln. About 75 gal. of water is sprayed per minute and of this about 20 gal. is evaporated and carried off with the gas.

The gases from the kiln are taken from the top of the stack, which is cut off at a point about 40 ft. above the base. In taking the gas at the top, instead of near the base, an advantage is derived from the fact that no dampers are required to control the flow of the gases, which may, at will, be discharged directly to the atmosphere or be drawn through the recovery plant by simply applying the suction of a fan. This arrangement leaves the kiln and its stack a complete unit independent of the recovery plant and permits of its operation with the least interference. The arrangement also tends to increase the safety in operation, as the stack is always open and ready to discharge the gas to the atmosphere in any emergency.

#### SPRAY WASH TOWER

About 35,000 cu.ft. per min. of gas enters a spray wash tower at the top, at which point the water sprays are also located. The tower is 6 ft. by 10 ft. inside in plan and 21 ft. high. At each 7-ft. level, a shelf projects part way across, leaving openings 4 ft. by 6 ft. at alternate sides of the tower for the gases to pass through.

The efficiency of the water sprays in gathering up these extremely fine dust particles would seem to depend entirely upon to what extent the water sprays are forced to take a different path from the gas and upon the velocity with which the drops of water are made to plow their way through the gas, it being assumed that the dust particle is caught by reason of the fact that it has appreciable size and weight and can not, therefore, get out of the path of the water drops fast enough, whereas the fume particles would veer off with the gas, due to their insignificant size and weight. For the same reason it would seem that fine atomization of the water is not desirable for the purpose of removing the dust, as the fine water particles would travel along with the gases, the same as the dust, and could not be thrown out by any zig-zag arrangement. The high efficiency as a dust collector obtained by this tower, considering the

large volume of gas handled and the comparatively small quantity of water used by the sprays, must be attributed to its small size, with the consequent high velocity of the gas through the tower, combined with the particular arrangement as outlined.

The gypsum crystallizing out on the walls of this tower must be removed at intervals of about 6 weeks. To facilitate this work, the floors, installed primarily for the purpose of giving the gas a zig-zag course, answer admirably as working platforms. Gypsum also crystallizes out in the pump and pipe lines as well as in the spray nozzles of the circulating spray system. The nozzles are removed daily and sand-blasted clean; the pump and pipe line require cleaning about every 6 to 8 weeks. The circulating spray system is installed in duplicate in order to allow time to remove the gypsum without interruption in the operation of the recovery plant.

#### DUST SETTLING CHAMBER

The efficiency of collection by the sprays can not be depended upon to remain constant at all times, on account of the variable condition of the nozzles, and therefore a supplemental gravity precipitation of the dust is resorted to, in order to control the quantity of dust escaping to the electrical treater. With the sprays in proper working order, about 95 per cent of the dust is removed from the gases in the spray tower, which leaves only a small quantity to be precipitated by gravity; the important object is not so much to remove this small amount of dust as it is to insure uniformity in the quality of the recovered product.

The chamber in which the dust is precipitated is 13 ft. wide by 30 ft. long by 7 ft. high and is located directly beneath the electrical treater chamber, from which it is separated by a floor having openings along the outer walls for the passage of the gas. The openings are of such size as to insure uniform distribution of the gas over the entire chamber. The gases from the spray tower enter this chamber through a large opening in one end, and as they enter they are passed toward the center of the chamber and from there divided and drawn to each side through the openings communicating with the treater chamber. The velocity of the gases is in that manner reduced without turbulence, thus affording excellent opportunity for the small amount of dust still present in the gases to precipitate to the floor. It has been demonstrated by the operation of this chamber that it is possible to settle out the very light and flocculent dust, without resorting to the use of dust-settling flues of prohibitive length and cross sectional area.

#### ELECTRICAL PRECIPITATION CHAMBER

The electrical treater is of chief interest in the entire installation inasmuch as it is the apparatus by which the salt fume is collected, but it is also of particular interest on account of its many unusual features. In the design of this treater, several distinct departures have been made from the usual types, described from time to time in the various publications. It will be observed from Fig. 1 that the treater is of the plate type, although the plates can not be directly seen, as they are covered with precipitated salts. The treater chamber is 13 ft. wide by about 34 ft. long. On each side of the chamber are benches or shelves above the floor; these are for the purpose of preventing the collected salt, as it drops from the treater to the floor, from passing through the openings into the dust settling

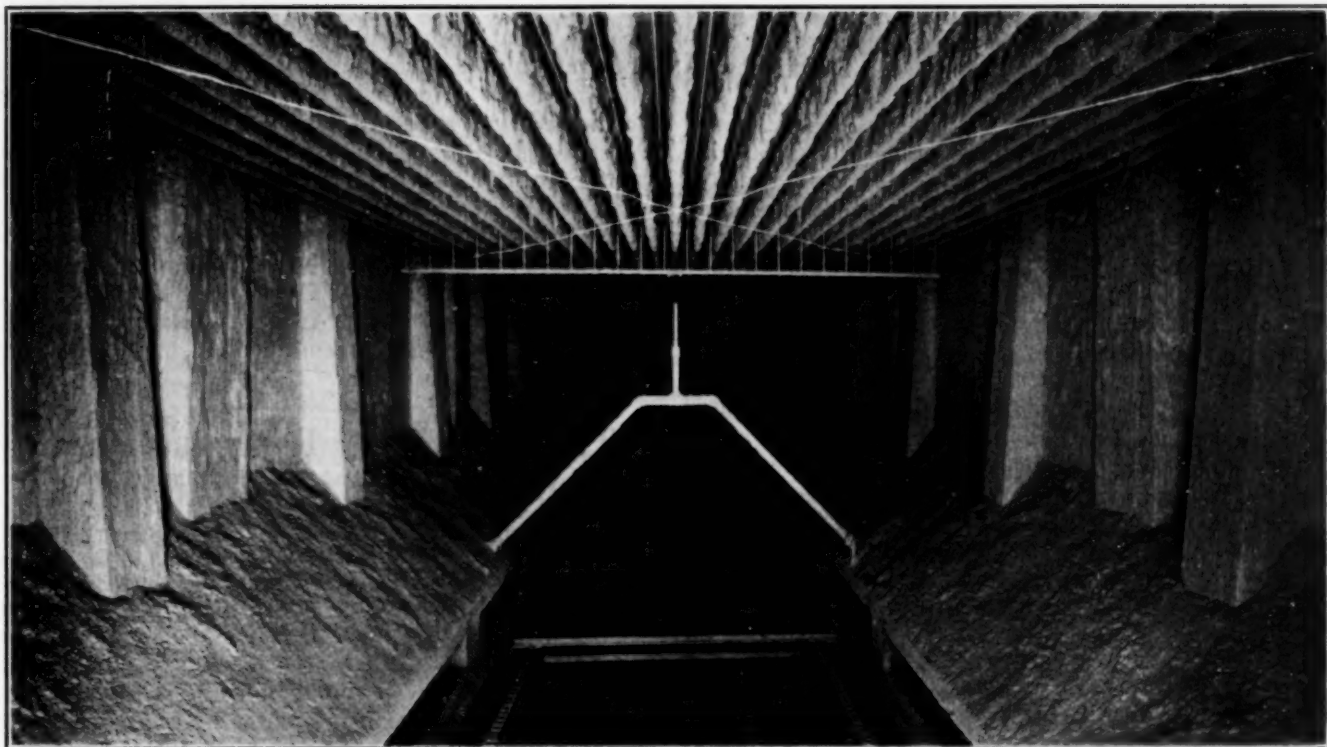


FIG. 1. INTERIOR VIEW OF PRECIPITATION CHAMBER SHOWING THE ELECTRICAL TREATER OVERHEAD

chamber below. The rectangular openings through which the gases enter this chamber are located immediately beneath the shelves. The gases in passing through the treater are distributed uniformly over the entire area by reason of the control obtained through the restricted openings left between the angle irons, which are riveted to the upper edge of the treater plates. These angle irons also serve to stiffen the plates and to keep them in alignment. The plates are suspended from cross beams on top of the treater and are bolted to these through the angle irons.

The outstanding feature of this treater is the large area employed in the collecting field for the gases to pass through. The velocity of the gas is therefore very low, less than 1 ft. per sec.; this permits of the salts, which have been precipitated by the treater, to drop to the floor against the gas current. In the customary types of pipe or plate treaters, it has usually been one of the objects to economize in the floor space occupied. As a result of this, the gas velocity through the precipitating field has been correspondingly high, which necessitated using long pipes or wide plates, as the case may be, in order to obtain good efficiency of collection.

A treater of this type, with pipes 13 ft. long, was experimented with, but did not prove entirely satisfactory, mostly because severe arcing interfered with precipitation and required too much attention on the part of the operator. It was found that these arcs were usually started by some of the deposited salt breaking away from the collecting surface, and as this salt was falling down through the pipe, an electrical disturbance was created that frequently resulted in the circuit-breaker "kicking out." This trouble was aggravated by the comparatively high velocity of the gas up through the pipes, and by the height of the pipe treater, which unduly delayed the salts in falling clear of the electrical field. To overcome these difficulties, the treater now in use at the plant was developed.

The plates in this treater are only 18 in. wide in

the direction of the flow of the gases, which therefore gives a rather narrow field for precipitation, but this is made up for by the large area employed. The treater is 12 ft. wide by 30 ft. long over the plates, and the plates are spaced 6 in. apart. Instead of suspending the electrode wires in the usual vertical position with the necessary weights at the lower end to keep them tight, the wires in this treater are suspended horizontally. By this arrangement the space underneath the treater is left entirely clear, with no obstructions on which the salts can accumulate and thereby invite trouble. The wires, which are two high and spaced 8 in. apart vertically, are strung from bus-bars, rigidly supported by insulators at each end of the chamber. No special provisions are made to take up any slack in the wires due to the expansion from heat, as the elasticity in the wire is sufficient to allow for this. In the middle of the span of the wires is suspended a light grid, which serves

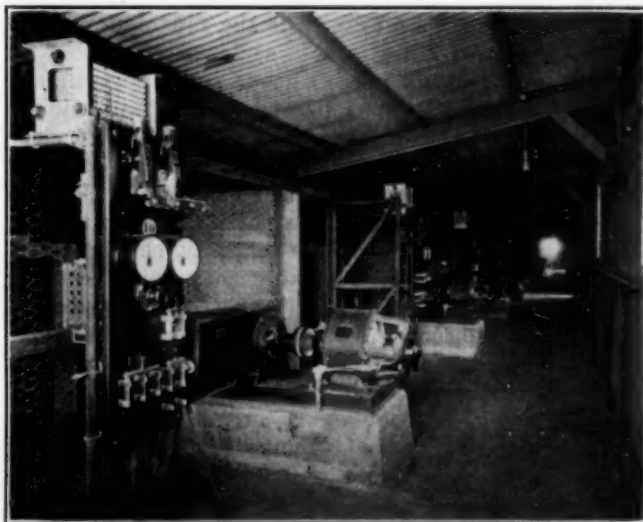


FIG. 2. VIEW OF POWERHOUSE SHOWING CONTROL OF MOTOR-GENERATOR SETS AND TREATERS

to steady the wires and is for that purpose prevented from swinging by diagonal wires running to the bus-bars. This arrangement is plainly seen in the view in Fig. 1.

An iron pipe frame may also be seen directly underneath the grid. This frame supports a small air hammer of a very simple construction, which is used for the purpose of stripping off any salts, that have been precipitated on the wires, by delivering a succession of light blows on the grid. The air hammer automatically withdraws, when not in use, so as to leave the necessary air gap, to avoid arcing from the grid. The air hammer, or some other similar device for vibrating the wires, is an essential part of the treater, since, without adequate cleaning, the wires become unevenly coated with salts, which will form in lumps the size of a fist. These distort the electrical field around the wire with a consequent falling off in the efficiency, besides making operation difficult on account of arcing. The wires are cleaned once an hour by the simple operation of turning on compressed air for a few seconds, which is done by the operator in the power house. (See Fig. 2.) No rapping device is used on the plates, as the salts precipitated on these, of their own accord, drop off during operation, when a certain thickness of deposit is reached. The voltage used on the treater is from 40,000 to 45,000 volts. The efficiency of collection is 75 to 80 per cent.

The salts, dropping to the floor in the treater chamber, are conveyed by a scraper conveyor to one end, where they are discharged through a set of slow moving rolls, directly into sacks. These rolls reduce the salts in bulk to about one-quarter. The salts as collected on the floor are very light, weighing only about 10 lb. to the cu.ft., but after they have been pressed into flakes by these rolls, the weight per cu.ft. is increased to about 40 lb., which makes it possible in shipping to load the cars to capacity weight. These rolls answer the double purpose of compressing the salts and at the same time discharge them to the outside of the chamber against a static pressure of the atmosphere of about  $1\frac{1}{2}$  in. of water over the gas pressure in the chamber. This difference in pressure is due to the suction produced by the fan drawing the gases through the plant.

The total power consumption for the recovery plant is about 40 hp. per unit, of which one half is consumed by the motor generator set for the electrical treater. The labor required on each shift to operate the plant consists of: one man to operate the 10 motor-generator sets and treaters; one man to operate the fans and circulating spray system (this man is assisted by another on the day shift only, in miscellaneous routine work) and one man to attend to the rolls and to weigh and tie the sacks of salts. Other labor used periodically to clean out the spray tower is about equivalent to one man employed continuously. The men engaged in filtering and drying the cake or dust are not included in this, as these operations should, without difficulty, be eliminated. It is of course possible to make even greater economy in the labor required by making the necessary provisions. This is a most encouraging feature—viz., that the limit of possibilities in economy have not been reached.

The use of waste-heat boilers to cool the gases instead of sprays would no doubt work in to good advantage, although the sprays should not be entirely eliminated, on account of the better results obtained on the treater by their use, and also because they tend to increase the safety in operation, by forming a barrier through which the flame from the kiln can not propagate to ignite com-

bustible gas, that may be present in the large chambers. The electrical equipment for supplying the high voltage current for the treaters is standard apparatus supplied by the Westinghouse Electric and Manufacturing Co., according to specifications furnished by the Western Precipitation Co. of Los Angeles, California. The treater and all other features in connection with the plant have been worked out at the works.

The responsibility for carrying the problems through to a successful solution rests with: George T. Cameron, president of the company; F. H. Davis, works manager; Fred Davis, superintendent; L. T. Bachman, chief chemist; E. W. Rice, chemist; and the writer, as mechanical engineer.

## The Electrolytic Reproduction of Engraved Printing Plates\*

BY WILLIAM BLUM† AND THOMAS F. SLATTERY‡

IN 1918 and 1919 the printing requirements of the Bureau of Engraving and Printing increased greatly owing to the large issues of bonds and other securities and to the increased demand for currency. In consequence it was found difficult to prepare the required number of printing plates by the mechanical transfer process, which was previously used entirely for this purpose. When electrolytic methods of reproducing these plates were first investigated it was found that although accurate reproductions could be thus obtained, plates which were similar to the ordinary electrotypes or even plates consisting entirely of electrodeposited copper did not possess sufficient strength to withstand the pressures used in plate printing. While conducting experiments in this connection, George U. Rose, Jr., chief of the engraving division of the Bureau of Engraving and Printing, discovered that by the deposition of alternate layers of nickel and copper it was possible to produce plates having the strength necessary for the purpose. This process of depositing alternate layers of copper and nickel, which has been patented by Mr. Rose, is the basis of the method now used in the new electrolytic plant of the Bureau of Engraving and Printing.

The more rigid requirements of plates to be used in "plate" or "intaglio" printing arise from the fact that in this process the designs (which are all below the plane surface of the plate) are filled with ink, and in order to cause the paper to pick up this ink considerable pressure is required. On the other hand, in using ordinary printing plates (upon which the characters are in relief) the lightest possible pressure is used between the paper and the type. Because of the greater pressure required in using engraved plates there is a tendency for these plates to curve in use unless they are sufficiently rigid to retain their form. Another special requirement for plate printing is that the surface shall have the greatest possible resistance to abrasion, as after each impression the plate is inked, rubbed with a mechanical wiper, and polished by hand, all of which operations exert more wear upon the plate than does the actual printing process.

The experimental work conducted at the Bureau of Standards toward the development of this process

\*Abstract of address delivered before the American Electroplaters' Society, July 1, 1921.

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upon a commercial scale consisted therefore in the determination of the best methods for securing (a) accurate reproduction, (b) a durable printing surface, and (c) the necessary rigidity.

#### ELECTRODEPOSITION OF MOLD OR ALTO PLATE

For the accurate reproduction of engraved printing plates it was found to be most satisfactory to prepare by electrodeposition a metal mold or negative of the original plate, rather than to attempt to take an impression in lead or wax, as in the ordinary electrotyping process. As upon this metal mold the designs are in relief, this plate has been designated as an "alto." One advantage of producing the altos by electrodeposition is that any change in dimensions such as might occur in wax or lead molding is avoided.

For the production of such an alto from a steel plate the latter is first thoroughly cleaned and is then brushed with graphite in order to permit subsequent separation. Nickel is then deposited directly upon this surface, after which alternate layers of copper and nickel are deposited until any desired thickness is obtained, which thickness is merely sufficient to insure reasonable rigidity when handling the alto in subsequent operations. This alto then serves as a form upon which to deposit the actual printing plate, known as the "basso," which is an exact duplicate of the original plate. Needless to say every precaution must be taken in these operations to avoid the presence of bubbles or foreign particles upon the surfaces during the initial deposition.

For the production of a durable printing surface the most promising metals are probably nickel, cobalt and iron. A few experiments were made upon cobalt deposition which, while by no means exhaustive, indicated that at least with our present knowledge satisfactory deposits can be more uniformly obtained from the nickel baths than from cobalt. A few experiments have been carried out by us upon the possible application of iron, but it was concluded that this method could not be considered for immediate adoption. As opportunity offers, further work will be done with cobalt, iron and other metals.

#### NICKEL DEPOSITED IN PRESENCE OF FLUORIDES

It is not difficult to obtain nickel deposits of great hardness, but unfortunately this hardness is usually associated with brittleness and with consequent curling and cracking of the deposit. It was found that by the addition of hydrofluoric acid or fluorides to the nickel solutions, as recommended some time ago by E. G. Lovering of Detroit, it is possible to employ higher current densities and to obtain deposits of greater tensile strength than in corresponding solutions containing chlorides instead of fluorides.<sup>1</sup> Satisfactory results have been obtained by using either nickel fluoride (prepared by the solution of nickel carbonate in hydrofluoric acid) or sodium fluoride. Operating at a current density of about 20 amp. per sq.ft. it is possible to obtain deposits of nickel up to a thickness of 0.02 in. or more with a tensile strength considerably over 100,000 lb. per sq.in. Some deposits have proved very satisfactory upon the printing surface. Up to this time no reliable means of measuring the "abrasion hardness" of thin layers of

metal has been developed, but as a first approximation it has been assumed to be proportional to the ultimate tensile strength.

As above noted, the use of alternate layers of copper and nickel leads to the production of plates of very much greater tensile strength than can be obtained with copper alone. Microscopic examinations of deposits thus produced shows that the beneficial effect of the nickel is not due alone or principally to the greater tensile strength of the nickel, but rather to the effect upon the structure of the deposited copper produced by the interdeposition of layers of nickel. The presence of each layer of nickel prevents further growth of the copper crystals and thereby causes the layer of deposited copper to have a higher tensile strength than it would if it consisted of coarse crystals. The use of nickel layers is also a great advantage in reducing the tendency to form trees, a tendency which is particularly objectionable in the production of thick deposits of copper at relatively high current densities. Except for the presence of the nickel layers it would be impossible to use the current densities here employed for copper deposition without producing very rough and badly treed deposits, which would require an excessive amount of labor for finishing and would represent a considerable waste of material.

#### PREPARATION OF THE BASSOS, OR PRINTING PLATES

In the actual production of the bassos, or printing plates, an initial coat of nickel is deposited at 10 to 20 amp. per sq.ft. for 6 hours and which has therefore a thickness of about 0.005 in. Alternate deposition of nickel and copper for periods of one hour each is then continued for about six days. The current density used for nickel is about 20 amp. per sq. ft. and for copper about 50 amp. per sq.ft. so that the relative thicknesses are approximately in the ratio of 1 to 3—in other words, the plates contain about 25 per cent of nickel. A final layer of copper is deposited for one or two days. This latter material is largely removed in the subsequent machining operations. Its principal purpose is to fill up any small depressions that may exist at the end of the alternate deposition.

After separation the plates are machined and ground by means of appropriate equipment to a thickness of 0.25 in. and to the desired size. Plates prepared in this way are now being used successfully for the printing of securities and are yielding impressions fully equal in appearance and accuracy to those prepared from steel plates. The present average service of the plates is about 40,000 impressions. It is believed, however, that by further improvements and by increased experience in the methods of using such plates this service may be appreciably increased.

Numerous details of the process are still under investigation. When these studies are completed it is expected to publish as a technologic paper of the Bureau of Standards a detailed description of the plant and equipment used for this purpose. The experimental work upon this process was conducted largely by W. E. Bailey, L. D. Hammond and H. E. Haring of the Bureau of Standards. Valuable suggestions and advice were received from George B. Hogaboom, electroplating adviser of this Bureau, and Charles Barbour, assistant superintendent of the electrolytic plant at the Bureau of Engraving and Printing.

<sup>1</sup>William Blum, "The Use of Fluoride in Solutions for Nickel Deposition," *Trans. Am. Electrochem. Soc.*, vol. 39, p. 227 (1921). *CHEM. & MET. ENG.*, vol. 24, p. 1109 (1921).

## Note on Notched Bar Impact Tests and Toughness of Monel Metal

BY R. G. WALTEMBERG\*

THE notched bar impact test occupies probably the unique position of being at the same time the oldest mechanical test known and one of the youngest in point of development with modern mechanical apparatus and measuring devices. The first one to apply this test was unquestionably the smith who used it first to break his bars and later to test roughly their quality. It was not until 1884 (Tetmajer), however, that the test was brought into a quantitative form by the measurement of the energy required to fracture a notched bar by a single blow. Since that time many prominent investigators have been associated with its development—Barba, Fremont, Vanderheyem, Charpy, Guillery, Martens, Heyn—and one can scarcely fail to be impressed today at its growing usefulness and importance in the testing and investigation of materials. Particularly in the field of alloy steels has the growth of its application been most rapid during the past few years, until it has been included in many commercial and government specifications for these materials.

### THE CHARPY AND IZOD TESTS

The test is now so well known that only the briefest mention of two of its more common forms is warranted in this place. In the Charpy impact testing machine the test-bar is supported horizontally at both ends on a double anvil and struck at the center by a weight swinging as a pendulum in a plane perpendicular to its axis. From the known height from which the center of gravity of the pendulum bob was dropped and the vertical distance to which it rises as it swings through after bending or fracturing the specimen, the energy may be computed which was absorbed in the deformation or fracture of the specimen, and this energy, expressed in foot-pounds or kilogram-meters, is the result as usually expressed of the test.

In the Izod, or the Olsen, machine one end of the specimen is clamped vertically in a vise and the pendulum bob swings down over the vise and strikes the specimen at a specified distance above the vise; the same method is used of measuring and expressing the energy absorbed in fracturing the specimen. The notch in the specimen for the Charpy machine is in the middle of the beam and is on the opposite side from that which the hammer strikes, and in the Izod, the specimen is clamped with the notch even with the ends of the clamps and on the side on which the hammer strikes. In each case the notch is at the point in the beam where the value of the shear passes through zero and the fiber stress is maximum and in tension.

The relations between the size and shape of specimen, design of testing machine and of foot-pounds of energy absorbed in the test are at present so little known that it has been necessary to standardize carefully both the specimen and the machine in order that different experimenters may obtain concordant results. Thus the energy absorbed in fracturing a specimen is not proportional to its cross-section, as are tensile and compressive properties. In this country the usual specimen for these machines is 10 mm. square in section

with a 45-deg. V-notch, 2 mm. deep, with root fillet of 0.25 mm. radius, although some use a specimen of the same size but with slightly different type of notch.

### VALUE OF THE NOTCHED BAR IMPACT TEST

It has been generally recognized that the notched bar impact test reveals properties and defects which are not usually shown in the results of the more common static tests such as the tensile, the torsion or the transverse bending test. In particular the result of this test expressed in terms of energy required to rupture seems to be the best single indication we have to date of the toughness, or conversely, the brittleness, of a material. It has therefore achieved perhaps its principal popularity with the users of alloy steels for automobile and aircraft construction, since the materials in these classes of service are subjected to rapidly applied stresses on parts with abrupt changes in cross-section.

In the non-ferrous field the impact test has been used chiefly up to the present time in the testing of light aluminum alloys,<sup>1</sup> but it appears that in this field also its usefulness and importance are growing rapidly. It has appeared worth while to carry out a brief series of impact tests on another prominent non-ferrous alloy, Monel metal, in order both to obtain additional data from which we might judge of the usefulness of the test in the non-ferrous field and to see what light the test would throw on the toughness property of this alloy.

### TESTS ON HOT-ROLLED MONEL METAL RODS

At the suggestion, therefore, of Dr. Paul D. Merica of the International Nickel Co., tests were carried out, both with the Charpy and with the Izod machines at

TABLE I. SOME MECHANICAL PROPERTIES OF HOT-ROLLED MONEL METAL

Rod No.	Material, In.	Prop. Limit, Lb. per Sq. In.	Yield Point, Lb. per Sq. In.	Breaking Strength, Lb. per Sq. In.	Elongation in 2 In., per Cent	—Hardness—				Izod Test Energy Absorbed, Ft.-Lb.	Charpy Test Energy Absorbed, Ft.-Lb.
						Red. of Area, per Cent	Brinell, 500 Kg.	Brinell, 3,000 Kg.	Scleroscope		
1	round	40,000	42,000	93,000	48	68	119	137	22	112	204
2	round	42,500	47,500	95,500	45	63	119	143	22	113	189
3	round	35,000	40,000	86,500	49	78	109	137	23	114	165
4	round	40,000	45,000	93,000	45	59	119	126	22	87	85
5	round	37,500	42,500	88,000	43	68	143	127	23	109	187
Ave. 1 round		39,000	43,400	91,200	46	67	122	136	22	107	166
6	round	37,500	42,500	87,500	43	68	109	131	19	110	209
7	round	42,500	47,500	97,000	45	61	119	149	23	120†	142
8	round	42,500	45,000	89,500	46	68	119	137	20	120†	198
9	round	47,500	50,000	93,500	43	59	143	149	22	76	95
10	round	42,500	47,500	98,500	45	61	119	137	23	109	123
Ave. 2 round		42,500	46,500	93,200	44	63	122	141	21	107	153

\* None of the specimens fractured in the Izod machine. In some cases the specimens bent enough to allow the hammer to pass and cracked less than one-fourth their thickness.

† Hammer did not pass specimen.

the Bureau of Standards on specimens cut from stock, hot-rolled Monel metal rods 1 in. and  $\frac{3}{4}$  in. in diameter. These tests were carried out on specimens of the type mentioned above; the Izod machine was of 120 ft.-lb. capacity, built by F. H. Bultman, and the Charpy machine of 224 ft.-lb. capacity, built by Sauveur & Boylston. The dimensions of these machines with a discussion of the effect of variations in the dimensions

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<sup>1</sup> See article by E. H. Dix, "Charpy Impact Test as Applied to Aluminum Alloys," *Mining and Metallurgy*, No. 160, April, 1920.

TABLE II. IMPACT AND OTHER MECHANICAL PROPERTIES OF SOME METALS

No.	Material	Tensile Properties			Impact Test		
		Tensile Strength, Lb./Sq.In.	Yield Point, Lb./Sq.In.	Elong. in 2 In., Per Cent	Brinell Hardness	Kind	Impact Work, Ft.-Lb.
1	Copper bars.....	.....	.....	.....	.....	Charpy	35
2	Semi-hard carbon steel.....	.....	.....	.....	.....	Charpy	54
3	Semi-hard nickel steel.....	.....	.....	.....	.....	Charpy	46
5	Commercial aluminum, cast.....	13,500	.....	20	24*	Charpy	9
4	8 per cent copper-aluminum alloy, cast.....	22,900	.....	2	72*	Charpy	1
6	$\frac{1}{2}$ -in. nickel chromium steel rod, heat-treated C 0.39, Cr 0.73, Ni 3.54.....	126,600	108,600	16.4	269	Charpy	24
7	3 $\frac{1}{2}$ per cent nickel steel (C 0.36), heat-treated.....	185,000	171,000	14.5	342	Izod	22
8	Chromium-nickel steel (Ni 3.99, Cr 1.62, C 0.11): Annealed.....	124,500	52,500	23	198	Charpy	83
	Heat-treated.....	191,500	168,500	13	302	Charpy	86
9	Chromium-nickel steel (Ni 3.62, Cr 0.48, C 0.44), heat-treated.....	132,000	113,000	17	.....	Charpy	46
10	Various copper alloys with small amounts of Ni, P, Sn, Zn, As, etc.....	.....	.....	.....	.....	Charpy	35-70
11	Carbon steel, forged (C 0.60).....	.....	.....	.....	.....	Izod	4.2
12	Nickel steel, heat-treated.....	.....	.....	.....	.....	Charpy	87
13	Nickel-chromium steel, heat-treated.....	.....	.....	.....	.....	Izod	62
14	Usual minimum specified value for heat-treated aircraft alloy steels.....	.....	.....	.....	.....	Izod	40
15	1-in. hot-rolled Monel rod (average of 5 tests).....	91,200	43,400	46	.....	Charpy	166
16	$\frac{1}{2}$ -in. hot-rolled Monel rod (average of 5 tests).....	93,200	46,500	44	.....	Charpy	153

\* 500 kg. pressure.

of the machine and specimens are given by E. H. Dix, *Proceedings, A.S.T.M.*, vol. 19, p. 720, 1919.

The results of these tests are shown in Table I. The average of five impact tests with the Charpy machine on specimens cut from 1-in. hot-rolled Monel metal rods was 166 ft.-lb., and on specimens cut from  $\frac{1}{2}$ -in. rods the average was 153 ft.-lb. The tests with the Izod machine were not satisfactory, as none of the specimens fractured and in some cases the hammer failed to pass the specimens. Attention may be called to the fact that in the Izod test the angle of bend is about 60 deg., while in the Charpy tests it is about 120 deg. The values of the impact energy absorbed in these tests are extraordinarily high and may usefully be compared with values which have been obtained on essentially similar specimens of other materials by other investigators and of which a compilation is given in Table II. It is most interesting that the energy absorbed in fracturing Monel metal in impact is much

TABLE III. AVERAGE TENSILE PROPERTIES AND TOUGHNESS FACTORS OF MONEL METAL AND OTHER MATERIALS

	Tensile Strength, Lb./Sq.In.	Elongation in 2 In., per Cent	Quality Factor*
Hot-rolled Monel rod 1-in. in diameter	.....	.....	.....
International Nickel Co. booklet.....	94,600	40	1,580
Heat-treated carbon steel (SAE 1045) drawn to 1,000 deg. F.....	106,000	19	920
Heat-treated 3 $\frac{1}{2}$ per cent nickel steel (SAE 2335) drawn to 1,200 deg. F.....	186,000	15	1,160
Heat-treated nickel-chromium steel (SAE 3320) drawn to 500 deg. F.....	150,000	23	1,440
Annealed wrought copper.....	35,000	50	730
Wrought manganese bronze.....	70,000	30	870
Wrought aluminum bronze.....	70,000	30	870
Wrought aluminum.....	13,000	30	170

\* Product of tensile strength and elongation divided by  $2 \times 100 \times 12$ .

greater than that required to fracture any other materials of which the author has seen the record of tests, including even heat-treated alloy steels. This would indicate a very uncommon degree of toughness, surpassing that of the steels.

A little consideration will show, however, that this fact is not entirely unexpected. Until the advent of the impact test, engineers had been in the habit of combining those tensile values—tensile strength or yield point—which are indicative of strength with those—elongation or reduction of area—which are indicative of ductility in some manner to give a single expression as an indication of toughness. Thus a simple manner of doing this was to integrate the area under the stress-strain diagram of the tensile test of a material, which is the energy required to rupture the specimen in static tension. Still simpler is the method of multiplying the elongation in per cent by the ultimate

tensile strength, which is also of the dimensions of energy and not greatly different from the value obtained by integration of the stress-strain diagram. In Table III are shown average values of these quantities for some materials together with their product in each case expressed in foot-pounds per square inch of cross-section. This quality factor of toughness for Monel metal is again seen to be greater than that of any other material.

For the benefit of those who might wish to compare this property of Monel metal with any of its other physical and mechanical properties the following summary is given of the approximate average physical and mechanical properties of Monel metal in the hot-rolled condition as determined by various observers:

Tensile strength (1-in. hot-rolled rod), lb. per sq.in.....	94,600
Yield point (tension), (1-in. hot-rolled rod), lb. per sq.in.....	63,100
Proportional limit (tension), (1-in. hot-rolled rod), lb. per sq.in.....	40,000
Elongation in 2-in. (1-in. hot-rolled rod), per cent.....	40
Young's modulus, lb. per sq.in.....	23,000,000
Brinell hardness (3,000 kg.).....	160
Specific gravity of rolled Monel.....	8.97
Electrical resistivity, microhms per c.c.....	42
Electrical resistivity, ohms per mil-ft.....	256
Thermal conductivity, cal. per deg. C. per sec. per c.c.....	0.06
Thermal expansivity, per deg. C.....	$14.0 \times 10^{-6}$
Melting range, deg. C.....	1310-1350
True specific heat, cal. per g. per deg. C.....	0.109
Optical reflectivity, per cent.....	60
Magnetic induction for $H = 100$ , gauss.....	1,500

### Coconut Oil Export From the Philippines

The total export of coconut oil from the Philippines during the first quarter of 1921 amounted to \$4,854,985, which was \$264,196 more than the export for the same period in 1918, but \$2,816,551 and \$3,562,952 less than the exports for the corresponding periods of 1920 and 1919, respectively. The highest single monthly exportation during the four years mentioned was in January, 1919, when the shipments of oil from the Philippines totaled \$6,098,069, at an invoice value of 30c. per kilo. The United States and the Netherlands were the only countries that absorbed the exports for the first quarter of 1921, while in previous years Great Britain, Spain and France shared a good portion of the Philippine output. Of the total export for this period \$3,190,407, or approximately 66 per cent, went to the United States; \$1,661,668, or about 34 per cent, to the Netherlands; and \$2,910, or less than 1 per cent, to all other countries.

The copra exported for the first quarter of 1921 was valued at \$1,912,133. That the copra trade is becoming active is shown by the fact that for the first quarter of 1920 the total export was \$10,148 only. In 1918 and 1919 the total exports of copra for the first quarters were \$122,219, and \$3,036,871, respectively, states the *Bulletin* of the Philippine Government Commercial Agency.

## Legal Notes

BY WELLINGTON GUSTIN

### George Patent for Cooling Bed Held an Advance in Art and Valid

The United States District Court, in the case of the Morgan Construction Co. vs. the Donner Steel Co., held the George patent, No. 863,841, valid as making an advance in the art in which it is used. This patent relates to improvement in conveyors for metal rods used in rolling mills, and commonly called cooling beds.

The object of the inventor was to make the supporting and lifting bars of such shape and form that, when acting in combination, they would serve to hold the heated metal in contact and automatically straighten it while being moved step by step or by intermittent movements from one end of the cooling bed to the other. The specification stated that the inventor does not wish to confine himself to the curved form of the supporting surfaces of the lifting bars, as the desired result was achievable by other forms.

The steel company defended the suit on the grounds of lack of novelty and invention and non-infringement. The evidence showed that in making steel ingots, billets, bars, etc., of varying lengths, the heated metal as it emerges from the run-out of the mill is ordinarily cooled on a conveyor or cooling bed before it is handled. A large number of separate pieces of hot metal are usually placed on the cooling bed, arranged side by side and moved intermittently across it. It is desirable that the metal bars or billets should not in their heated condition come in contact with one another, as experience has shown that by contact they are often bent or distorted; and hence it is necessary that they should be moved on supporting surfaces, which help to prevent or correct any curves or bends in them. To accomplish this the supporting members of the device in suit are notched, and the notches aligned with corresponding wave-shaped depressions in the lifting member, so that the lowest part of the notches upon which the heated metal rests comes in the same plane with the depressions on the lifting member.

#### INVENTION NOT A GENERIC ONE

The court says the invention was not in any sense a generic one. The separate elements of the combination of the claims in suit were old, but the inventor was the first to combine in a single apparatus the step by step arrangement present in the known straight-edged bar device and in old devices with serrated edges on bars or skids aligned for carrying the hot rods by a rocking or oscillating mechanism of the skids or bars.

The prior patents issued to Johnston, to McDonald and McKee for so-called shuffle bar conveyors, to Edwards, to Kellogg for gravity notched cooling beds, to Geer, the so-called Illinois and Republic and Austrian cooling beds, disclose types of known devices. Such structure the patentee designed to improve, since the hot rods were bent in their travel in the shuffle bar conveyors, while the rocking and gravity devices operated on a different principle.

The court found in none of these the elements combined as in the patent in suit. By his new combination of old parts or elements separately shown in prior de-

vices the court thought the patentee advanced the art a little, producing a new and useful result, one operating upon a somewhat different idea from prior patents. The law is that a combination of old elements, if they have been combined to operate in a new way or to accomplish a new and useful result, is patentable.

The defendant company in its cooling bed adapted a similar combination to plaintiff's patent without having any prior actual knowledge of this patent. And since the serrations on the surface of the lifting support are of different shape, defendant claimed that a departure from the patent in suit resulted by its adoption, that a new use eventuated, in that the hot bars, after being lifted by the sides of the serrations, are allowed to slide or tumble to the bottom as they are carried over the edged surfaces of the stationary support. The court thought that the tumbling or sliding action of the hot rods after the lifting began was due in the main to lateral adjustment of the serrated bars and to the form of the serrations. And the changes in the serrations were changes of form only, and any improvements resulting therefrom were such as a skilled mechanic could make.

Finally, it was contended that plaintiff's device is impracticable since only one cooling bed had actually been constructed, its construction being under the broad claim only. But the court held that the utility of the invention is established by the fact that defendants have persisted in infringing it. (Cf. Rumfort Chemical Works vs. New York Baking Powder Co., 134 Fed., 385.)

The court further says that under our laws a patentee is not obliged to manufacture the apparatus described in the patent. Its non-use does not deprive him of the protection of the patent laws.

### Quality of Motor Gasoline

That the quality of gasoline has been maintained despite the fact that the stocks on hand at the refineries have been the greatest on record and that retail prices have been materially reduced is indicated by preliminary data obtained from the examination of samples collected in Washington, D. C., by the United States Bureau of Mines in its fourth semi-annual survey of the motor gasoline sold commercially throughout the country. While the average quality of gasoline now being sold is very similar to that sold a year ago, there is a noticeable difference in the shape of the distillation curve, due presumably to the increasing use of benzene blends in the eastern part of the country. The preliminary figures also confirm the deductions of previous surveys that there is a decided difference between the gasoline sold in summer and that sold in winter.

The average boiling point of gasoline sold in Washington a year ago was 279 deg. F. Today it is 278 deg., a negligible difference. Last winter the boiling point averaged 270 deg., and the winter before 267 deg.

Below are given the average distillation figures for the samples so far collected in Washington. While there is little change in the average boiling point as compared with a year ago, the difference in the actual character of the fuel, indicating increased use of benzene blends, is particularly noticeable at the 50 per cent point:

	First Drop	20%	50%	90%	End Point
July, 1920.....	131	200	273	396	449
July, 1921.....	128	202	259	390	445

## Chicago's Relation to the Future American Steel Industry

An Analysis of the Economic Location of a Steel Industry in View of Modern Practice in Coal Economy, Diminishing Ore Tenor, Increasing Amount of Scrap Used, and the Greater Influence of Freight on Finished Product

BY GERARD DE GEER  
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**T**HE ore comes to the fuel," says a well-known rule in reference to the location of a steel plant. The past history of the steel industry over the whole world has proved the correctness of this expression. The center of gravity of the steel industry in the United States is consequently placed near the large coal and oil fields, and the ore is transported from other places. The German steel industry has been developed around the coal fields of Westphalia and Silesia, with the ore imported chiefly from France and Sweden. England is so fortunate as to have the coal and ore supply in common; at several places the ore and coal are even brought up from the same mine shaft.

In a natural way the location of the steel industry was determined by transportation facilities. If we go back half a century, when modern steel industry on a large scale began to develop, we find that it required about 2.3 tons of ore to produce 1 ton of manufactured steel with a consumption of 3 to 4 tons of coal. Under such circumstances it was considerably cheaper to transport the ore to the coal than *vice versa*.

### DIMINISHING FUEL REQUIREMENTS

The question, however, is often raised whether these relations between ore and coal are fixed once for all and are unchangeable. It may be answered immediately. Certainly not. They are governed by the laws of progress. We find that the consumption of coal per ton of iron during the last decades has been gradually reduced, by a better utilization of the fuel combined with new metallurgical and thermotechnical methods. Formerly the gas from coke ovens and blast furnaces was allowed to waste into the atmosphere; nowadays this gas is very carefully collected and forms quite an important source for the production of heat and power. Formerly the steel was allowed to cool off between the different metallurgical processes. Now the pig iron is taken in a molten state from the blast furnaces to the steel-making departments, and the hot ingots are taken directly to the mills. The consumption of coal per ton of manufactured steel has accordingly during the last few years been reduced to about one-half the amount used fifty years ago, and it is safe to assume that the bottom level has not as yet been reached. Up-to-date modern steel mills need at the present time an insignificant amount of fuel in addition to the coke consumed in the blast furnaces. All other demands for heat and power are covered by the use of gas and tar from coke ovens and blast furnaces. Sometimes even an excess supply of gas or power is available which can be used outside the plant and which partly compensates for the quantities of coal that may be

necessary for certain purposes over and above the amount of coal for coking. Under such circumstances the coal supply is reduced to 2 tons or less per ton of manufactured steel.

### DECREASING ORE TENOR

If we turn to the ore we will find the development to be in the opposite direction. A saving of ore in the same sense as that of coal is not possible. At all times practically all the iron has been recovered from ore smelted in the blast furnace. Small losses in slag and dusty gases are unavoidable, and even if they could be eliminated their importance would be insignificant. On the other hand, the consumption of ore per ton of pig iron is being gradually increased, due to a lower percentage of iron in the ore.

The best and richest ore is already mined and it becomes gradually necessary to use poorer ore. The average percentage of iron in the ore being used at the present time in the United States hardly reaches over 50 per cent, while a few years ago it was about 55 per cent. In Germany this retrogression is still more striking; there the average percentage of iron in ore has decreased from 54 to 41 per cent in forty years. A continued diminution of the percentage of iron in the ore is most likely to occur, even though it is partly counterbalanced by an increased number of ores which are concentrated.

One may readily ask the question whether or not the same condition prevails with regard to the deposits of coal—viz., that the best grade of coal has been consumed and that its quality decreases as mining continues. Such is not the case. When the upper coal strata have been mined it will be necessary to go deeper into the earth for further mining; the price of coal will be higher, but its quality, on the other hand, will be better rather than worse. The higher cost of mining leaves the question of transportation between mine and mill unchanged. Besides, the total supplies of coal are so enormously greater than the visible supply of what we now know as iron ore that shortage of the latter will ensue far sooner than of the former.

A table showing the relative distribution of the amount of transportation between manufactured products and the two most important raw materials, coal and iron, is given below, using the assumption that 1.25 tons of pig iron is required for 1 ton of ingots and 1.5 tons of coal for 1 ton of coke:

	1870	1920
Ore.....	2.3 tons, or 34.0%	2.5 tons, or 45.4%
Coal.....	3.5 tons, or 51.3%	2.0 tons, or 36.3%
Manufactured product...	1.0 tons, or 14.7%	1.0 tons, or 18.3%

From this table it is seen that the reasons for the location of the iron industry, judging from the transportation point of view, have been changed quite considerably. Ore and coal have almost changed places and the importance of transportation of manufactured steel in relation to the raw materials has increased. It is to be noted particularly that these changes have been accentuated in a considerable degree during the last two decades. Its consequences already show themselves in certain tendencies in the development of the steel industry. The rule mentioned at the beginning of this article, that the ore comes to the fuel, is nowadays a truth only with modification.

If one considers the steel industry of the United States he finds that an unquestioned movement has taken place in direction from the coal to the ore. Branches have reached out from the Pittsburgh steel center toward the north and met the Lake Superior ore, and toward the east to the imported ores. At present there is a steel district of considerable size at the south shore of Lake Michigan with Chicago as the center. A rapidly growing steel industry has also been developed near the earliest location of the American industry, the Atlantic coast around Boston, Baltimore and Philadelphia. It is shown by production statistics that these steel districts have grown considerably more rapidly than the original ones. For instance, the production of pig iron, in accordance with the official statistics of the United States, has progressed in the following manner during 1900 to 1918 in the two districts as given below:

Year	Pennsylvania, Tons	Illinois and Indiana, Tons
1900.....	6,365,935	1,527,095
1910.....	11,272,328	3,925,749
1918.....	15,198,271	6,513,906

Pennsylvania is the home of the original steel industry of the United States and maintains still a predominant position in comparison with other states. The two other states as given in the above table represent a new steel district, which has grown up in the last thirty years at the south end of Lake Michigan. The percentage of increase within the latter district from 1900 to 1918 has been 326 per cent, while the corresponding figure for Pennsylvania is 140 per cent.

In judging the question of ore versus coal it will be necessary to give some attention to the fact that not all kinds of coal are suitable for the steel industry. For example, in order to obtain good coke for the blast furnaces a special brand of coal is required. It is true that there are enormous supplies of coal in Indiana and Illinois, and on that ground it seems absurd to talk about a movement toward the Mesabi ores from the coal which is to be used for the steel industry that has been located in that district. These coal supplies are, however, of such a quality that they are not, as a rule, suitable for production of coke without mixing. The largest part of coal used for coking by the Chicago industries is consequently taken from the coal fields in Pennsylvania and Kentucky.

#### ILLUSTRATIONS FROM EUROPE

Movement of the steel industry toward the ore can be shown more distinctly in Germany. About thirty years ago there was hardly any steel manufactured in Lorraine (now French). At the present time the coal comes from Westphalia and the Saar district and to a

large extent is transported to the western part of the country, where a rapidly growing steel industry has been developed around the large ore fields of Lorraine. The more important steel and iron districts of Germany proper also show the same tendencies of evolution. Thus, the steel interests in Upper Silesia have sent branches to the Baltic Sea, where a couple of large steel mills have grown up, using Swedish ore and Silesian and Westphalian coal.

#### INFLUENCE OF SCRAP

In judging the influence of transportation on the steel industry due consideration must also be given another factor of rapidly growing importance. An investigation of the statistics of production in the United States shows that a replacement has occurred in the relations between the tonnage of pig iron and of steel. Up to 1910 the former was greater than the latter, but since 1911 steel has outdistanced pig iron, as is shown in the following table:

Year	Pig Iron, Tons	Steel, Tons
1890.....	9,202,703	4,277,071
1895.....	9,446,308	6,117,834
1900.....	13,789,242	10,188,329
1905.....	22,992,380	20,023,947
1910.....	27,303,567	26,094,919
1911.....	23,649,547	23,676,106
1915.....	29,916,213	32,151,036
1917.....	38,647,397	45,060,007

The thing which has caused this reversal is the use of scrap iron in the manufacture of steel. Scrap iron has therefore become a third standard raw material for the steel industry, competing in importance with the older two, ore and coal.

Daily experience tells us that only an insignificant part of the enormous quantities of iron which are being discharged into the world's markets is destroyed in the true sense of the word. Much the largest part of it is saved from the destroying elements and sooner or later it is returned to the steel mills in the form of scrap iron. Through this cycle the loss of ore and coal as well as of labor will become less in spite of the growing demand for iron.

The period required for this circulation of iron is naturally quite variable. Steel from which tools and machines are fabricated can be used only for a few years; in rails and ship plates it lasts 10 to 40 years, but when steel is used as building material and reinforcement for concrete construction its life may be hundreds of years. The transposition of a steel product into scrap iron is in a large measure dependent upon other factors than the real wear and tear or the disintegration of the iron. The many technical advancements and the ever-continued progress in every line of business have become a factor of enormous importance in producing scrap iron. All kinds of machinery are being scrapped because they are not modern and up to date; rails are being exchanged, not because they are worn out but for the reason that increased train speed requires heavier locomotives and stronger rails; perfectly good buildings are torn down and replaced with new ones because they no longer correspond to the increasing demand for hygiene and comfort. The real disintegration of iron is less than is generally conceded. It is reduced chiefly to such objects as shoe tacks, horseshoe nails, rims on wagon wheels, etc., or is caused by accidents, such as shipwrecks and fires. In a machine that weighs about 10 tons only a few pounds

of its metallic contents are subjected to real wear—as for example the edge of a tool. Worn-out rails have in many cases lost only a few per cent of their original weight; in fact the formation of rust is usually a more dangerous enemy to iron than mechanical wear.

#### IRON CIRCULATING IN FABRICATION PROCESSES

The time has not yet arrived when the effects of the circulation of iron have become felt to the full extent. We must realize that the production of iron on a large scale commenced only with the introduction of the bessemer and open-hearth processes during the latter half of the last century. Before that the world's production could without difficulty be produced at the present time in a couple of the larger steel mills in the United States. We are now living in a period when the return flow of used-up iron to the steel mills has just started. There can be no doubt that this flow will grow in size.

As late as at the beginning of this century practically all the steel was produced from pig iron—that is, directly from ore. The older metallurgical methods did not permit of anything but a very limited use of scrap iron. Conditions are entirely different now. It is hardly possible to say exactly how large a part of the steel comes from pig iron and how large a part from the addition of scrap, as this figure cannot be obtained directly from the statistics. Consideration must be given to the fact that not all of the scrap iron used is material which has been returned to the steel mills as an actual increase of the raw materials, but that part of it is a waste product in the mills themselves, formed during the process of fabrication, defectives, crop ends and trimmings. Because the statistics usually show the production of steel in form of raw ingots the iron that comes from this continuous circulation within the mill will be included in the figures for the total production.

#### SCRAP WITHIN THE MILL

Were it possible to count the production in manufactured goods, then the condition would be different, but this cannot be done for the reason that the line between partly manufactured goods and completely finished products is very changeable. It is true that the largest part of the products of the steel mills is shipped direct without further treatment—such as, for example, rails, structural shapes and pipes. A considerable portion, however, undergoes additional processes of fabrication, resulting in a certain amount of scrap—for example, all iron which is delivered to machine shops. Scrap iron from these industries must be counted in the same class with that of the steel mills. It is not an actual addition to the supply, but must rather be considered as part of the unavoidable circulation; the time cycle involved is hardly longer than for the scrap iron produced within the mill itself.

A calculation which cannot necessarily claim to be exact but which in all probability comes pretty near reality will show that the iron that comes from this circulation during its production and further fabricating processes corresponds to 20 per cent of the weight of the produced ingots. In order to conceive the importance of the real circulation of iron—that is, the quantity of iron which has actually been in use, worn out or scrapped for any other reason and then returned to the steel mills—it will be necessary first to reduce the statistical figures for production of ingots

by 20 per cent and then to calculate how much of the remaining portion comes from the pig iron and the scrap iron respectively.

#### STEEL FROM BONA FIDE SCRAP

If the American production of ingots during 1917 is used as a basis for the calculation, it will be shown that about 82.5 per cent of the weight of iron comes directly from the ore and the remaining 17.5 per cent from the real scrap. The calculation has been made as follows: The production of ingots during 1917 in the United States was 45 million tons. From this is deducted 20 per cent, that portion derived from iron circulating in the manufacturing processes, leaving 36 million tons. The production of pig iron during the same year was 38.6 million tons. In order to determine how much of this pig iron was finally obtained as steel it will be necessary to reduce the above figure not only by the production of iron castings (about 14 per cent) but also by the iron losses which follow the change of pig iron to steel (about 9 per cent). Final figures are thus: The

portion of pig iron  $38.6 - \frac{23}{100} \times 38.6 = 29.7$  million tons. The amount of scrap iron entering into the ingots must then be  $36 - 29.7 = 6.3$  million tons, or 17.5 per cent.

Considering the effect of scrap iron on the relation between transportation and the production of iron in accordance with the above the following tabulation may be made for the year 1917:

Ore.....	2.05 tons, or 41.0 per cent
Coal.....	1.75 tons, or 35.0 per cent
Scrap.....	0.2 tons, or 4.0 per cent
Manufactured product.....	1.0 tons, or 20.0 per cent

It must be stated that these figures do not pretend to be fully exact, because they are partly based on deductions and assumptions. The object of this article is, however, to give a picture of the general trend of progress and not to show complete statistical calculations. It is further assumed that the errors which eventually may be found in the above figures are not great enough to affect perceptibly the final conclusions.

From this tabulation it is shown that the third great class of raw materials has not as yet affected the question of transportation as related to the steel industry to any extent. The conclusions drawn when consideration was confined to the ore and coal are in a broad sense unchanged. The relative importance of transportation to the disposal of the manufactured goods has, however, increased somewhat.

I repeat that the movement of the steel industry from the coal toward the ore, the beginning of which is already distinctly noticeable, will with all probability be more and more accentuated in the future. Of course we can never expect any complete move in this direction, as a certain equilibrium will be established under the influence of the possibilities for return freight among other factors. Market for manufactured steel and the increasing importance of the scrap supply will in the future exert a greater influence upon the choice of new locations for a steel plant. The question of railroad accommodations will be decisive in relation to both factors. It is necessary to have good transportation facilities to already established markets, as well as, and particularly, to the new fields which the future will probably open for the consumption of iron. An effec-

tive utilization of the scrap iron is altogether dependent upon the transportation facilities. The supply of scrap is not concentrated; it is made up from a multitude of smaller supplies located at places far apart. A net of transportation lines is required in order to collect the scrap and transport it to the place where it is to be used. The railroads themselves are, for that matter, big iron users as well as scrap producers.

#### ECONOMIC ADVANTAGE OF CHICAGO DISTRICT

It must be admitted that hardly any steel-manufacturing district in the United States has such favorable future possibilities as the Chicago district when judged according to above-given viewpoints. Its location corresponds to the economical equilibrium between the coal and the ore. It is situated in the focus of the greatest outbranching network of railroads in the world, with the gate open toward west and north, where new and great market possibilities are waiting. Its shores are washed by an inland sea offering favorable means for supply and distribution, a lake which may become a bay of the Atlantic when the plans for new connecting canals are realized. The leading position of Chicago in trade and communication will reach out to include also the most important of all industrial products—steel.

### Exports of Chemicals During the Past Fiscal Year

ACCORDING to the Bureau of Foreign and Domestic Commerce reports, the fall in value of our exports of chemical products during the present industrial depression has not been much during the last four months of the fiscal year, ended June 30. As compared with the figures for the corresponding months of 1920, this group of exports showed a decrease of 54 per cent in February, 72 per cent in March, 70.6 per cent in April, 75.3 per cent in May, 73.3 per cent in June. The total value of the shipments during the latter month was \$4,178,685, as compared with \$15,685,322 in June, 1920, and \$4,366,119 in May, 1921. Three items only show an increase in 1921 over the export total for June, 1920; glycerine advanced in amount from 44 short tons to 52 short tons; its value, however, fell from \$21,638 to \$18,740. Calcium acetate increased from 13 tons (\$6,714) to 898 tons (\$29,212). Benzene, as during the preceding months, registered a notable upward movement from 590 tons (\$79,728) to 2,920 tons (\$187,237).

#### ARTICLES SHOWING LARGEST FALLING OFF

The articles which suffered most seriously in this fall were the following:

Nitric acid, 44 tons to 4 tons; miscellaneous coal-tar crudes, \$890,530 to \$35,163; copper sulphate, 193 to 28 tons; coal-tar dyes, \$2,389,515 to \$444,273; formaldehyde, \$212,925 to \$33,360; bleaching powder, 2,199 tons to 449 tons; petrolatum, \$322,431 to \$63,153; potassium chlorate, 255 to 16 tons; miscellaneous potassium compounds, \$304,616 to \$34,067; borax, 865 to 83 tons; caustic soda, 11,514 to 1,620 tons; soda ash, 7,341 to 2,130 tons.

#### COMPARISON WITH TWO PRECEDING YEARS

Far less serious was the shrinkage in the amount and value of our chemical exports for the fiscal year, ended with June 30, as compared with the two preceding years.

In 1919 the total value of such exports was \$148,053,531; in 1920 it was \$158,691,918; in 1921 it fell to \$110,284,401. This is a decrease of 30.5 per cent as compared with 1920, and 25.5 per cent as compared with the total for 1919. Increase over the 1920 figures is registered for four products. Bleaching powder advanced from 15,616 short tons (\$840,092) to 18,713 short tons (\$1,146,378); sodium bicarbonate, 5,999 to 6,672 tons; benzene, 8,627 to 33,311 tons; miscellaneous coal-tar crudes, \$3,618,424 to \$4,101,129. Soda ash fell from 58,727 to 56,741 tons, but the value rose from \$2,804,130 to \$3,308,783. The most noteworthy decreases in our exports of chemicals during the past fiscal year were as follows:

Baking powder and glycerine, 38 per cent; formaldehyde, 40 per cent; miscellaneous chemicals, 42 per cent; sulphuric and miscellaneous acids, 43 per cent; miscellaneous dyes, 47 per cent; roots, herbs and barks, 54 per cent; caustic soda, 56 per cent; borax, 57 per cent; all potassium compounds and calcium acetate, 61 per cent; nitric acid, 67 per cent; carbolic acid, 71 per cent.

#### HOLDING OUR SHARE OF FOREIGN MARKET

In view of the lowered prices of numerous chemicals it is evident that we are holding a fair share of the foreign market for these products, gained by our unceasing efforts during the war period. It is equally evident that only by a similar strenuous effort can the market over there be held in the face of the determined resolution of the German chemical trade to win back as much as possible of its control in this branch of commerce. The accompanying table furnishes comparative details of the movement into the world's consuming markets of our American chemicals and allied products during the fiscal years ending with January, 1920 and 1921:

EXPORTS OF CHEMICALS AND ALLIED PRODUCTS FOR  
THE FISCAL YEAR ENDING JUNE 30, 1920 AND 1921  
(Quantities in Pounds Unless Otherwise Stated)

Acids:	1920	1921
Carbolic.....	\$2,223,305	\$659,890
Nitric.....	820,517	267,119
Picric.....	8,073	3,730
Sulphuric.....	32,334,393	18,600,704
All other acids.....	5,292,987	3,029,332
<b>Total acids.....</b>	<b>\$6,600,687</b>	<b>\$3,612,703</b>
Alcohol, wood, gal.....	687,008	467,763
Baking powder.....	5,595,126	3,491,666
Bleaching powder.....	31,232,379	37,425,093
Calcium acetate.....	32,885,132	12,845,700
Calcium carbide.....	21,164,404	20,147,753
Coal-tar distillates:		
Benzene.....	17,253,314	66,622,862
All others.....	3,618,424	4,101,129
Copper sulphate.....	4,511,284	4,297,378
Dyes and Dyestuffs:		
Coal-tar colors.....	17,190,397	13,577,788
Logwood extract.....	1,832,231	1,471,040
All other dyes.....	6,829,937	5,571,309
<b>Total dyes.....</b>	<b>\$25,852,565</b>	<b>\$18,620,137</b>
Extracts for tanning.....	6,016,438	1,732,198
Formaldehyde.....	2,289,217	1,376,281
Glycerine.....	2,257,623	1,388,194
Potassium Compounds:		
Chlorate.....	2,845,858	1,130,771
All others.....	3,362,827	1,309,852
Roots, Herbs and Barks:		
Ginseng.....	220,970	157,351
All others.....	1,793,064	836,320
Sodium Compounds:		
Bicarbonate.....	11,988,510	13,353,769
Borax.....	10,943,110	4,368,880
Caustic.....	229,146,363	101,021,827
Sal soda.....	12,763,399	10,376,424
Silicate.....	33,692,535	23,099,660
Soda ash.....	116,555,500	113,481,062
All other sodium salts.....	7,485,008	5,353,600
<b>Total sodium compounds.....</b>	<b>\$21,499,421</b>	<b>\$15,470,235</b>
Sulphur, long tons.....	393,404	375,826
Washing powder.....	6,114,816	4,021,497
All other chemicals, drugs, etc.....	42,179,732	24,458,956
<b>Total chemicals, drugs, etc.....</b>	<b>\$158,691,918</b>	<b>\$110,284,401</b>

## Measuring Gases Containing Water Vapor

Accurate Measurement of Gases Saturated With Water Vapor Requires a Determination of Density—  
Velocity Formulas Modified to Use Specific Gravity Values Determined  
Graphically—Procedure for Partially Saturated Gases

By THOMAS G. ESTEP\*

IN THE various industries where devices are used for measuring large volumes of gases it is found that practically all such gases contain a certain amount of water-vapor. Byproduct coke-oven, producer and blast-furnace gases are nearly always saturated with water vapor at the moderate temperatures, while atmospheric air is usually only partially saturated.

The necessity for correcting gas measurement for water vapor is often overlooked by engineers with the result that large errors obtain. The extent of such errors may be more appreciated by pointing out that in a particular problem which is referred to later in this paper, if the gas had been considered as dry instead of saturated, the error in the volume under standard conditions would have been 5.3 per cent. When it is considered that with the devices for measuring gases, if carefully handled, will give results correct within one per cent, it is apparent that the error due to neglecting the water vapor is much larger than the errors due to observation.

### FORMULAS FOR VELOCITY

Of the various methods employed for measuring gases—Pitot tubes, Venturi meters, orifices and throttle disks—all produce a measurable differential pressure which bears some relation to the velocity of the gas. In the case of the Pitot tube, this differential pressure or head is directly proportional to the square of the velocity but in the case of the other devices mentioned, this head only represents change in velocity. Expressed in the form of equations: For Pitot tubes,

$$V_1^2 = 2gh$$

For Venturi meters, orifices and throttle disks where the differential pressure is small enough so that changes in specific volume of the gas may be neglected,

$$V_2^2 - V_1^2 = 2gh$$

Where

$V_1$  = velocity of gas in main pipe, feet per second.

$V_2$  = velocity of gas at smallest section, feet per second.

$g$  = acceleration due to gravity, feet per second per second.

$h$  = differential pressure expressed in feet of the gas at the pressure and temperature at the point of measurement.

The differential pressure  $h$  is usually measured in inches of water, oil or mercury. To convert it into equivalent feet of gas it is only necessary to divide by 12 and multiply by the ratio of the density of the water, oil or mercury to the density of the gas under the conditions at the point of measurement. This sounds comparatively simple but the labor lies in the determination of the density of the gas at the point of measurement

because it is the density of a mixture of gas and water vapor. This can be determined by chemical analysis, but the process, while not difficult, is very laborious. The density can, however, be calculated from more easily determined data.

### CALCULATION OF DENSITY OF A MIXED GAS

To illustrate this method of finding the density of a gas when saturated with water vapor and the determination of the velocity of the mixture in the pipe, a concrete problem will be solved. Assume that the average velocity head of a certain gas has been determined by the Pitot tube and is 3 in. of water. The gas at the point of measurement has a temperature of 85 deg. F. and an absolute pressure of 34 in. Hg and is saturated with water vapor. The chemist reports that this gas, when dry at a temperature of 62 deg. F. and an absolute pressure of 30 in. Hg, has a specific gravity of 0.4 referred to air at the same temperature and pressure as unity. It is first necessary to determine the density of air at a temperature of 62 deg. F. and an absolute pressure of 30 in. Hg. This can be done by using the characteristic equation of a perfect gas.

$$d = \frac{P}{RT}$$

Where

$d$  = density, pounds per cubic foot.

$P$  = absolute pressure in pounds per square foot.

$R$  = gas constant, foot pounds per degree F.

$T$  = absolute temperature of the gas, degrees F.

Substituting,

$$d = \frac{144 \times .49117 \times 30}{53.34 \times (62 + 459.6)} = .07627 \text{ lb. per cu.ft.}$$

The density of the dry gas at 62 deg. F. and 30 in. Hg =  $.07627 \times 0.4 = .03051$ . By consulting the steam tables, it is found that at a temperature of 85 deg. F., the vapor pressure is 1.209 in. Hg. and the vapor density is 0.001832 lb. per cu.ft. If the total pressure of the mixture of gas and water vapor is 34 in. Hg and the partial pressure of the vapor is 1.209 in. Hg, then according to Dalton's law, the partial pressure of the gas in the mixture is  $34.000 - 1.209 = 32.791$  in. Hg. In one cubic foot of the mixture there is one cubic foot of gas at a temperature of 85 deg. F. and an absolute pressure of 32.791 in. Hg and one cubic foot of saturated water vapor at an absolute pressure of 1.209 in. Hg. The weight of the one cubic foot of gas at a temperature of 85 deg. F. and an absolute pressure of 32.791 in. Hg is,

$$\text{weight, lb. per cu.ft.} = .03051 \times \frac{62 + 459.6}{85 + 459.6} \times \frac{32.791}{30.000} = .031940$$

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The weight of the mixture of gas and water vapor per cubic foot is

weight of mixture, lb. per cu.ft. =

$$.031940 + .001832 = .033772.$$

This is the density of the mixture at the point of measurement.

The specific gravity of the mixture at the point of measurement, referred to air at a temperature of 62 deg. F. and an absolute pressure of 30 in. Hg as unity is,

$$\text{Specific gravity of mixture} = \frac{.033772}{.076270} = .4428.$$

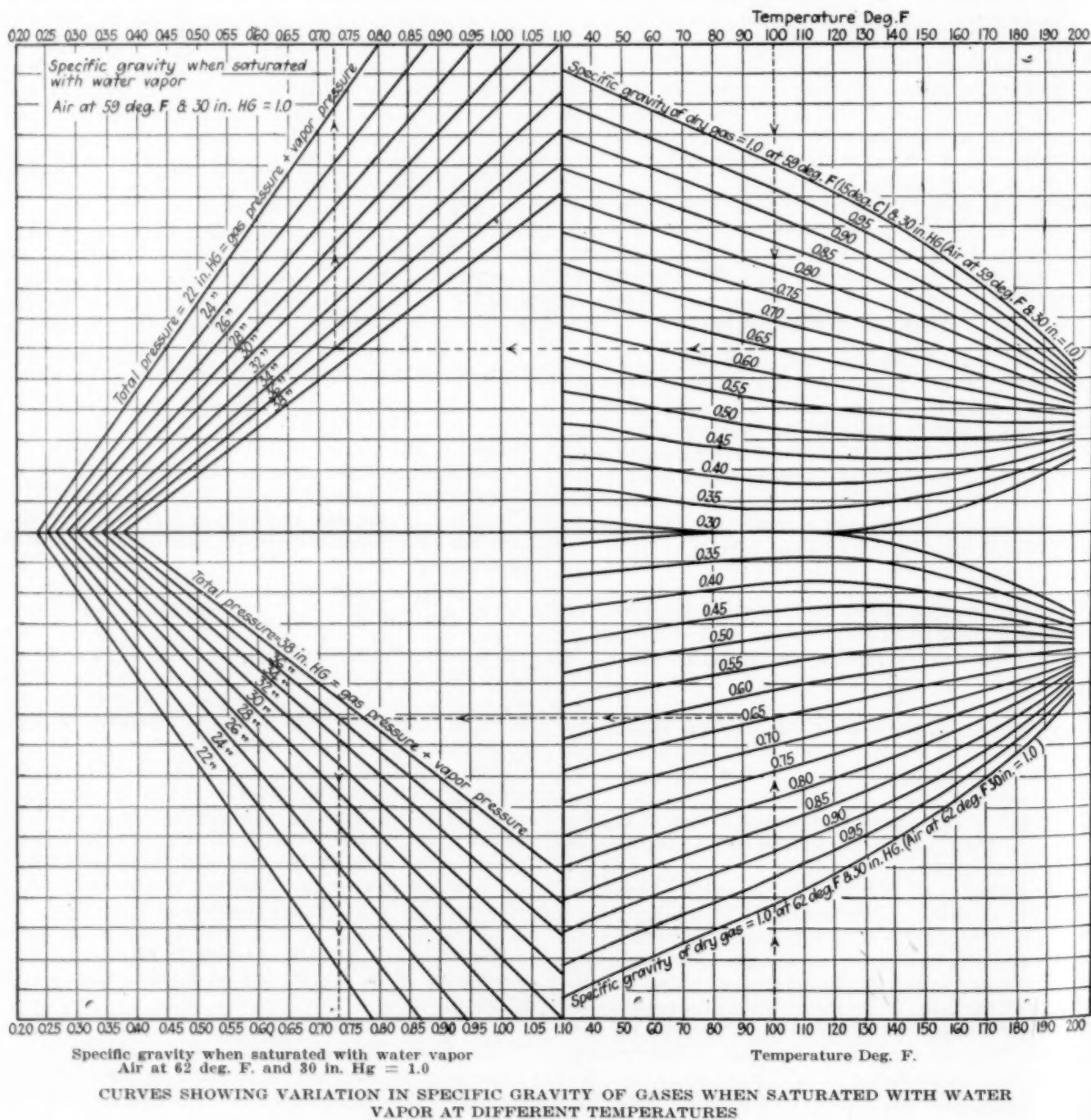
The equivalent feet of gas corresponding to the 3-in. water velocity head is,

$$\text{Feet of gas} = \frac{3 \times 62.4}{12 \times .033772} = 461.92.$$

The velocity of the gas in the pipe is then,

$$\text{Velocity, ft. per sec.} = \sqrt{2 \times 32.16 \times 461.92} = 172.37.$$

It can be readily seen from the above that the determination of the density of the mixture at the point of measurement is rather laborious, hence a set of curves has been prepared from which the specific gravity of the gas when saturated with water vapor at various temperatures and pressures can be read directly, thus avoiding the tedious calculation. Two families of curves are given in the accompanying figure, one for a base of 62 deg. F. and 30 in. Hg and the other for 59 deg. F. (15 deg. C.) and 30 in. Hg. The abscissa of the curves at the right of the diagram is the temperature of the mixture at the point of measurement. The curves above are the specific gravities of the dry gas referred to air at the base temperature and pressure as unity. The straight lines to the left are lines of constant pressure of the mixture at the point of measurement while the abscissa for this set is the specific gravity of the gas when saturated with water vapor at the given temperature and pressure, referred to air at a temperature and



pressure corresponding to the base as unity. The dotted line shows how to use the curves for any condition.

Since these curves give the specific gravity of the mixture at the point of measurement the equations for velocity will be modified so that the values from the curves can be substituted directly. When air at 62 deg. F. and 30 in. Hg is taken as a base, for Pitot tubes the velocity is

Velocity, ft. per sec. =

$$\sqrt{\frac{2 \times 32.16 \times 62.4 \times H}{12 \times .07627 \times S}} = 66.22 \sqrt{\frac{H}{S}}$$

Where

$H$  = velocity head, inches of water.

$S$  = specific gravity of the mixture at the point of measurement referred to air at a temperature of 62 deg. F. and an absolute pressure of 30 in. Hg as unity.

When air at 59 deg. F. and 30 in. Hg is taken as the base; for Pitot tubes the velocity is,

$$\text{Velocity, ft. per sec.} = 66.02 \sqrt{\frac{H}{S}}$$

Where

$H$  = velocity head, inches of water.

$S$  = specific gravity of the mixture at the point of measurement referred to air at a temperature of 59 deg. F. and an absolute pressure of 30 in. Hg as unity.

For Venturi meters, orifices and throttle disks where the differential pressure is small enough so that changes in specific volume of the gas can be neglected, the equation for velocity becomes,

Velocity at smallest section, ft. per sec. =

$$K \times C \sqrt{\frac{H}{S \left[ 1 - \left( \frac{A_2}{A_1} \right)^2 \right]}}$$

Where

$K$  = a constant = 66.22 or 66.02 depending upon what condition of air is taken as a base.

$A_1$  = inside area of main pipe where upstream pressure is measured.

$A_2$  = area of smallest cross section.

(Both these areas must be in the same units.)

$C$  = orifice coefficient.

This coefficient for Venturi meters is usually taken as unity. For well-rounded or so-called standard orifices it varies from .95 to .99 depending largely upon the size of the orifice. For throttle disks, the coefficient varies greatly for different conditions and should be determined experimentally.

Where the differential pressure is great enough to cause an appreciable change in the specific volume of the gas as it passes through the device, then the above equation will not hold and the general equation for frictionless adiabatic flow must be used.

#### VOLUME DETERMINED FROM VELOCITY

After the velocity of the gas has been determined, if this velocity in feet per second is multiplied by the area of the section in square feet, the result is the volume of the mixture of gas and water vapor flowing, in cubic feet per second at the pressure and temperature at the point of measurement.

Very often the volume of dry gas at some standard condition, such as a temperature of 62 deg. F. and an

absolute pressure of 30 in. Hg, is wanted instead of the volume of wet gas. To find this, multiply the volume of the mixture by the ratio of the absolute gas pressure in the mixture to the absolute pressure at the standard condition and further, by the ratio of the absolute temperature at the standard condition to the absolute temperature of the mixture at the point of measurement.

For example; suppose that the area of the section in the problem already solved is such that when the velocity of 172.37 is multiplied by this area the result is, for convenience, 100 cu.ft. per sec. This means that there are flowing 100 cu.ft. per sec. of a mixture of gas and water vapor at a temperature of 85 deg. F. and a total absolute pressure of 34 in. Hg. The equivalent volume of dry gas at a temperature of 62 deg. F. and an absolute pressure of 30 in. Hg is,

$$\text{Vol. dry gas} = 100 \times \frac{32.791}{30.000} \times \frac{62 + 459.6}{85 + 459.6} = 104.5 \text{ cu. ft.}$$

In some cases it is desired to know the equivalent volume of gas when saturated with water vapor at some other condition of pressure and temperature as a standard. To illustrate; suppose that it is desired to know the equivalent volume of gas when saturated with water vapor at a temperature of 62 deg. F. and an absolute pressure of 30 in. Hg. From the steam tables, the vapor pressure at a temperature of 62 deg. F. is .560 in. Hg. The absolute gas pressure under the new conditions will then be 30.00 — .56 = 29.44 in. Hg and the equivalent volume at 62 deg. F. and 30 in. Hg is,

Volume saturated gas at 62 deg. F. =

$$100 \times \frac{32.791}{29.44} \times \frac{62 + 459.6}{85 + 459.6} = 106.7$$

#### PARTIALLY SATURATED GASES

So far, only the case where the gas is completely saturated with water vapor has been considered. When it is desired to determine the volume of air delivered by fan, compressors or turbo blowers and the measurements are made with sufficient accuracy to justify making a correction for water vapor, the problem becomes more involved due to the fact that in practically all cases the air is only partially saturated. In such cases the procedure would be as follows: Determine the wet and dry bulb temperatures of the gas at the point of measurement. From a psychrometric chart find the dew point temperature for this condition. Then from the steam tables find the vapor pressure and density corresponding to the dew point temperature and proceed as in the previous problem. This method is correct only when the total pressure is 30 in. Hg, for practically all psychrometric charts are based on this pressure and for any great variation in the total pressure from the above the relative humidity or the dew point should be calculated from the original equations. In nearly all cases in actual practice the total pressure of the gas at the point of measurement is nearly atmospheric so that the error from the procedure mentioned will be small.

#### TNT for Road Building

TNT, in the opinion of Thomas H. MacDonald, chief of the Bureau of Public Roads, is an ideal explosive for use in road construction. Through his bureau 26,000,000 lb. has been distributed for that purpose without an accident. As TNT does not freeze and the fumes do not produce headaches it is popular with road contractors.

## The Training of the Glass-Works Chemist

BY ALEXANDER SILVERMAN

IN AN article which appeared recently in the *Pottery and Glass Record* and was reprinted in an American journal<sup>1</sup> Dr. W. E. S. Turner of the Department of Glass Technology of Sheffield University called attention to the lack of a course in Glass Technology in the curricula of our institutions of learning. The writer outlines the following course of study to "start the ball rolling," and invites discussion. Numbers indicate the actual hours per week scheduled for classes, the first figure signifying lecture and recitation hours, the second, laboratory.

### FIRST YEAR

- First term.—General inorganic chemistry (4-6)  
General physics (3-3)  
Advanced algebra (5)  
German (3)  
English (3)
- Second term.—General inorganic chemistry (4-6)  
General physics (3-3)  
Trigonometry (5)  
German (3)  
English (3)
- Third term.—General inorganic chemistry (4-6)  
General physics (3-3)  
Analytical geometry (5)  
German (3)  
English (3)
- Fourth term.—Such general work in a glass factory as requires no special technical training.

### SECOND YEAR

- First term.—Advanced inorganic chemistry (2)  
Qualitative analysis (1-9)  
Advanced physics (light) (2-6)  
German or French<sup>2</sup> (3)  
Analytical geometry (5)
- Second term.—Advanced inorganic chemistry (2)  
Qualitative analysis (1-9)  
Advanced physics (Heat) (2-6)  
German or French (3)  
Calculus (5)
- Third term.—Advanced inorganic chemistry (2)  
Quantitative analysis (1-9)  
Advanced physics (Study and determination of physical properties of glass) (2-6)  
German or French (3)  
Calculus (5)  
Graphics (3 practice)
- Fourth term.—General work in a glass factory.

### THIRD YEAR

- First term.—Physical chemistry (3-3)  
Quantitative analysis (1-9)  
Mineralogy (2-6)  
Gas and fuel analysis (2-6)  
French (3)
- Second term.—Physical chemistry (3-3)  
Quantitative analysis (Raw materials for glass) (1-9)  
Geology (5)  
Fuel values. Pyrometry. (3)  
French (3)
- Third term.—Physical chemistry (3-3)  
Quantitative analysis (Glass) (1-9)  
Microscopy (1-6)  
Organic chemistry (2-6)  
French (3)
- Fourth term.—Analytical laboratory practice in a glass factory.

### FOURTH YEAR

- First term.—Clays and refractories (2-6)  
Glass technology (2-6)  
Ceramic calculations (2)  
Engineering laboratory (2-6)  
General economics (3)  
Library work (5)
- Second term.—Glass technology (3-9)  
Ceramic calculations (2)  
Electrical engineering (2-6)  
Economics (Factory management) (3)  
Library work (5)
- Third term.—Glass technology (3-12)  
Electrical engineering (2-6)  
Economics (Labor and costs) (3)  
Library work (5)

The writer considers it necessary to discuss only a few of the courses in detail, as most of those listed are familiar to all engaged in teaching. In the short courses in mineralogy and geology special attention must naturally be given to raw materials used in the glass industry. The course in microscopy should cover both microchemical and petrographic methods.

Under glass technology one should include furnace and lehr design; fuels; raw materials; preparation of batches; melting and refining; furnace control; glass manipulation; annealing; physical and chemical properties of glasses; manufacture of plate, window, bottle, illuminating, chemical, optical, water glass, table ware and fused quartz; etching, silvering, enameling and decorative processes; glass substitutes. The laboratory work should include the preparation of various glasses and the study of their properties. The course in ceramic calculations supplements that in glass technology and affords the student practice in the handling of mathematical problems encountered from time to time.

Some may think that the glass chemist is so specialized a being that there will be but little demand for him in the industry. The writer feels that with the training prescribed he will, with practical experience in the industry, develop into a very important factor.

As stated in the introduction the paper was presented to arouse discussion. This is earnestly invited.

Department of Chemistry,  
University of Pittsburgh.

### Statement of Austrian Iron and Steel Concern for 1920

The net profits of the Alpine Montan Gesellschaft, which comprises nearly all of the Austrian iron and steel industry, for 1920 were 28,564,704 crowns as compared with 10,697,928 crowns during the preceding year, according to a report received from C. H. Foster, with the American Mission, Vienna. The volume of annual sales for 1920 was 1,930,000,000 crowns against 246,000,000 crowns for 1919. On April 20, 1921, the company decided to pay on May 10 a dividend of 25 per cent, or 50 crowns, per share. Last year the dividend was 10 per cent, or 20 crowns, per share; in 1916 it was 50 crowns; and in 1912 it was 52 crowns per share.

The year seems to have been very prosperous, but the higher figures were really caused more by higher prices and a depreciated currency than by a greater quantity of production and economy of operation. In general, production at the end of the year was about 22 per cent of capacity. In comparison with the company's best year—1916—iron ore was produced at the rate of 18 per cent; pig iron, 14.5 per cent; rolled iron, 27.5 per cent; and steel, 24.5 per cent.

<sup>1</sup>*Glass Industry*, vol. 2, 1921, p. 10.

<sup>2</sup>Students who have had three years of German should begin French.

## Carbon Black From Natural Gas in 1920

BY E. G. SIEVERS

THE total quantity of carbon black produced from natural gas in the United States in 1920 was 51,321,892 lb. and 43,500,000 lb. in 1919. In 1919 the plants were still operating at or near full capacity on account of the war, but since normal conditions have been restored the production has decreased.

The output in 1920 was made by thirty-nine plants, operated by nineteen producers, whereas in 1919 only thirty-six plants were operated by sixteen producers. The total value as computed from the prices received by the producers was \$4,032,286 for 1920 and \$3,816,000 for 1919. The prices ranged from 4c. to 27c. a lb. in 1920 and from 3c. to 27c. in 1919. The average daily production in 1918 was 120,830 lb.; in 1919, 144,600 lb.; and in 1920, 140,608 lb.

About 40,600,000,000 cu.ft. of natural gas was consumed in the manufacture of carbon black in 1920, as compared with 49,896,200,000 cu.ft. in 1919 and 45,000,000,000 cu.ft. in 1918. In 1920 the production of carbon black per thousand cubic feet of gas consumed ranged from 0.45 to 2 lb., but the average production during the year for all states was about 1.26 lb., as compared with 1.04 lb. during 1919. Table I gives the range in production of carbon black at plants in the United States in 1919 and 1920.

TABLE I. RANGE OF PRODUCTION OF CARBON BLACK IN 1919 AND 1920

Production	Plants	
	1919	1920
Less than 1 lb. ....	6	6
From 1 to 1.2 lb. ....	17	19
From 1.3 to 1.6 lb. ....	11	6
From 1.7 to 2.0 lb. ....	2	8
	36	39

The daily capacity of the plants in volume of gas treated ranged from 172,000 to 20,350,000 cu.ft. as against 72,000 to 18,360,000 cu.ft. in 1919; the quantity of carbon black produced was from 90 to 23,250 lb. as against 90 to 22,900 lb. in 1919.

Tables II and III give the production by states for 1919 and 1920. West Virginia remained the leading producing state in 1920, although its output decreased 11 per cent. The annual decrease in production in West Virginia and in Pennsylvania is due in part to the diminishing supply of gas, which has made it possible to sell for fuel at higher prices large volumes of gas that would otherwise be used in making carbon black.

Louisiana, which has made rapid growth in the carbon black industry during the last few years and was second in rank, increased its production by 32 per cent

in 1920. The great supply of gas in the Monroe field accounts for this marked increase in production. Louisiana will continue to be a large producer of carbon black unless prevented by legislation.

Oklahoma produced no carbon black in 1920. The combined output of Wyoming, Montana and Kentucky decreased 4 per cent, so that Louisiana was the only state showing a substantial increase. The producing states, named in order of production and the percentage of the output they produced, are West Virginia, 52 per cent of the total output; Louisiana, 36 per cent; Wyoming, Montana and Kentucky combined, 11 per cent; and Pennsylvania, 1 per cent.

TABLE III. CARBON BLACK PRODUCED FROM NATURAL GAS IN THE UNITED STATES IN 1920

State	Number of Plants	Carbon Black Produced			Gas Used	
		Quantity, Lb.	Value	Average Price	Quantity, M.Cu.Ft.	Average Yield per M.Cu.Ft.
West Virginia....	19	26,659,469	\$2,221,674	8.2	18,628,780	1.35
Louisiana.....	15	18,565,498	1,455,764	7.8	18,099,800	1.0
Wyoming.....	1	5,850,313	326,424	5.6	3,673,108	1.6
Montana.....	1					
Kentucky.....	1					
Pennsylvania....	2	246,612	28,424	11.5	197,290	1.2
	39	51,321,892	\$4,032,285	7.8	40,598,978	1.26

The carbon black industry migrates according to the available supplies of natural gas. West Virginia has always been the center of manufacture, but Louisiana and Wyoming have made rapid growth. As natural gas is an ideal domestic fuel, the consumers demand that it be reserved for domestic uses, and the carbon black industry has, therefore, migrated to localities where there are abundant supplies of natural gas for which there is only a small market or no market at all. The Monroe gas field, in Louisiana, one of the largest in this country, has been a favorable location for carbon black plants, for it is remote from large cities and towns and supplies but little gas for domestic uses, and the gas is sold at a fairly low rate, so that the carbon black industry has there become well established. The producers are now installing plants that remove the gasoline from the gas before it is consumed in the manufacture of carbon black, which is another means of conservation.

In Wyoming the conditions are somewhat similar to those in Louisiana. The general market for the gas produced there is small, so that the carbon black industry has been developed until Wyoming has surpassed Oklahoma and assumed third rank among the producing states.

A cubic inch of carbon black contains approximately 1,905,000 sq.in. of surface, whereas a cubic inch of lampblack contains only 1,524,000 sq.in. Carbon black therefore consists of finer particles and is superior to lampblack for use in both the printing and rubber industries.

Carbon black is an amorphous form of soft carbon produced by the incomplete combustion of natural gas. It is sometimes confused with lampblack, which is made by burning oil or some other raw material and which differs from carbon black in molecular structure and tinctorial strength as well as in quality and in use. Its lightness and fineness, freedom from gritty particles, miscibility with oil, intensity of color and remarkable covering power when mixed with other materials are among its essential qualities.

Carbon black was first made commercially in this country about 1864, when it was first used in making

TABLE II. CARBON BLACK PRODUCED FROM NATURAL GAS IN THE UNITED STATES IN 1919

State	Number of Plants	Carbon Black Produced			Gas Used	
		Quantity, Lb.	Value	Average Price, c.	Quantity, M. Cu.Ft.	Average Yield per M. Cu.Ft.
West Virginia....	23	29,925,614	\$2,358,119	7.8	23,117,332	1.3
Louisiana.....	7	14,024,606	933,334	6.6	20,291,021	0.7
Wyoming.....	2	4,868,947	231,747	4.7	4,306,153	1.1
Montana.....	2					
Oklahoma.....	2					
Kentucky.....	2	2,922,274	244,726	8.3	1,954,129	1.4
Pennsylvania....	2	315,500	48,114	15.0	227,700	1.3
	36	52,056,941	\$3,816,040	7.3	49,896,235	1.04

printing ink. The growth of the industry has been stimulated by the rapid increase in the publication of books and newspapers, which demand a constantly increasing supply of carbon black for the manufacture of printing inks adapted to fast press work. The modern rotary printing presses now used by daily newspapers and printing establishments require an ink that will dry rapidly and yet permit the presses to be operated at a high speed—an ink that will flow freely, possess great covering power and make an instantaneous and legible impression—and an ink having all these qualities

TABLE IV. SUMMARIZES THE APPROXIMATE DISTRIBUTION BY USES OF CARBON BLACK IN 1918, 1919 AND 1920

Use	1918 <sup>a</sup>		1919		1920	
	Per Cent	Quantity, Lb.	Per Cent	Quantity, Lb.	Per Cent	Quantity, Lb.
Rubber	45	20,000,000	40	20,822,400	40	19,947,000
Printer's ink	23	10,000,000	35	18,219,600	35	17,454,000
Export	18	8,000,000	15	7,808,400	15	7,480,000
Miscellaneous	14	8,500,000	10	5,205,600	10	4,986,000
	100	43,500,000	100	52,056,000	100	651,321,892

<sup>a</sup> Estimated by Bureau of Mines.

<sup>b</sup> Exact total obtained from producers.

can be made by using carbon black. One pound of carbon black mixed with 8 lb. of oil and other chemicals will produce enough ink to print 2,250 copies of a sixteen-page newspaper of ordinary size or 90 copies of a 300-page octavo book. Prior to 1864 lampblack was used in making printing ink, but as carbon black proved to be superior for this use it rapidly displaced lampblack. About 35 per cent of the total annual output of carbon black is now incorporated in printing ink.

#### CARBON BLACK IN THE RUBBER TIRE INDUSTRY

The introduction of carbon black in the manufacture of rubber tires has been of considerable consequence in the rubber tire industry. The addition of carbon black, which is a reinforcing agent, has given the rubber greater toughness and resiliency, better traction and a longer mileage. It has increased the tensile strength and the elasticity of the tire about 25 per cent and 10 per cent, respectively. During 1920 a number of rubber tire manufacturers who formerly manufactured white tires have changed to the manufacture of "black tread tires," and are using considerable quantities of carbon black—indicating the increasing use of this product in the rubber industry, which consumes about 40 per cent of the output. The advantages of carbon black in making rubber tires have been established, but whether it is irreplaceable is still a matter of opinion among chemists.

About 10 per cent of the carbon black produced is used in the manufacture of stove polish, about 1 per cent in phonograph records, and about 2 per cent is distributed among miscellaneous uses, including black leather, black and gray paper, bookbinder's board, buttons, carbon paper, carriage cloth, celluloid, electric composition insulators, cement colorings, crayons, glazed paper, Chinese and India inks, marking and stenciling inks, artificial stone and black tile, paint, shoe polish, tarpaulins, type ribbon, varnish, etc.

Between 15 and 20 per cent of the output is exported. Before the war about one-third of the output was exported, but owing to unstable conditions the export trade has not resumed its normal proportions. Owing to the increased use of carbon black in the manufacture of rubber tires in this country, however, less of the product will probably be available for export.

## Macroscopic Examination of Iron and Steel

A COMMITTEE on metallography, appointed by the American Society for Testing Materials, has proposed the following tentative methods for testing iron and steel. Criticism of the methods is invited; it should preferably be addressed to G. F. Comstock, Titanium Alloy Manufacturing Co., Niagara Falls, N. Y.

In order to show up both chemical and crystalline heterogeneity, sections of iron and steel are more or less deeply etched in order to bring out their macrostructure. In this way the persistence of the dendritic structure of castings even after much heat-treatment and mechanical working, physical unsoundness such as blowholes, gas cavities, porosity, fine internal cracks and flakes, discontinuities of structure such as found in welding, flow of metal as in pressing and forging, are brought out.

Suitable sections are cut, smoothed and then ground on various grades of emery paper in order to obtain a smooth flat surface. In some cases it is necessary to continue polishing through No. 0 and No. 00 French emery papers. Other similar papers of domestic manufacture are also available and suitable for this purpose. The sample ought to have a surface free from grease and dirt; if necessary it is then freed from all grease by cleaning with gasoline and then alcohol when it is ready for immersion in the solution.<sup>1</sup>

#### SOLUTIONS USED IN ETCHING

Macroscopic etching of iron and steel was used as early as 1783 by Bergman. Many different solutions have been used and many of them are given by Campbell,<sup>2</sup> and more recently by Rawdon.<sup>3</sup>

Of the following, 1 (a) and 2 are recommended.

1. To show segregation and the like:

(a) Hot concentrated hydrochloric acid used at about 100 deg. C. A deep etched specimen may be printed with printer's ink.

(b) Etching for four to five hours with 5 per cent picric acid in alcohol.

2. To show variations in crystalline structure as well as segregation:

One to 2 g. of ammonium persulphate in 10 c.c. of water. This is probably the best reagent for developing this phase of the structure in iron and steel.<sup>4</sup>

3. To show the distribution of phosphorus.<sup>5</sup>

Various reagents containing copper chloride are used. The copper coats those portions which are low in phosphorus and leaves the high-phosphorus areas bright. It has recently been shown that nickel and other alloys give similar effects, also that oxide of iron acts in the same way. The accompanying list shows the various solutions which have been recommended:

Heyn:<sup>6</sup> Copper-ammonium chloride, 10 g., water, 100 c.c. A somewhat weaker solution is better, the specimen being etched two or three times in fresh solution if necessary. The liquid is gently agitated. The coating of spongy copper forming on the face of the specimen is easily removed with a swab of wet cotton. Portions high in carbon, sulphur and phosphorus will have darkened. If the copper

<sup>1</sup>For large sections various methods have been devised depending on the material. Surface grinding when carefully done gives excellent results.

<sup>2</sup>Proceedings, Am. Soc. Tes. Mat., vol. 25, Part II, p. 96 (1915).

<sup>3</sup>The Structure and Related Properties of Metals. Bureau of Standards Circular. (In the press.)

<sup>4</sup>Rawdon, "Macro-etching with Ammonium Persulphate," Scientific Paper 402, Bureau of Standards (1920).

<sup>5</sup>Howe, "Metallography of Steel and Cast Iron," p. 601. Charpy and Bonnerot, *Compt. rend.*, 1914, vol. 165, p. 536.

<sup>6</sup>Heyn and Bauer, *Metallographic*, 1909, vol. 1, p. 21.

film adheres, a 0.5 per cent solution of ammonium persulphate will facilitate its removal.

Stead:<sup>7</sup>  $\text{CuCl}_2$ , 10 g.;  $\text{MgCl}_2$ , 40 g.;  $\text{HCl}$ , 10 c.c.;  $\text{H}_2\text{O}$ , 20 c.c.; alcohol to 1,000 c.c. Dissolve salts in smallest possible amount of hot water and make up to 1,000 c.c. with absolute alcohol. For small specimens the reagent is applied drop by drop until structure is developed. The specimen is then washed with boiling water and then alcohol. Another method is to wash off the deposited copper with ammonia and so increase the contrast.

Le Chatelier and Lemoine:<sup>8</sup>  $\text{CuCl}_2$ , 10 g.;  $\text{MgCl}_2$ , 40 g.;  $\text{HCl}$ , 20 c.c.;  $\text{H}_2\text{O}$ , 180 c.c.; alcohol, 1,000 c.c. Applied like Stead's reagent. Contrast can be increased by electrolysis, using a single battery cell, keeping the current below 50 milliamperes.

Rosenhain and Haughton:<sup>9</sup>  $\text{Fe}_2\text{Cl}_6$ , 30 g.;  $\text{HCl}$ , 100 c.c.;  $\text{CuCl}_2$ , 10 g.;  $\text{SnCl}_4$ , 0.5 g.;  $\text{H}_2\text{O}$ , 1,000 c.c. The copper adheres firmly. Pearlite areas remain bright. Ferrite darkened by deposited copper, the purest parts darkening the fastest. Pitting can be avoided by diluting the reagent.

LeChatelier and Dupuy:<sup>10</sup> Ethyl alcohol, 100 c.c.;  $\text{H}_2\text{O}$ , 10 c.c.;  $\text{CuCl}_2$ , 1 g.; picric acid, 0.5 g.;  $\text{HCl}$  (concentrated), 1.3 to 2.5 c.c., varying with material.

Oberhoffer:<sup>11</sup> Ethyl alcohol, 500 c.c.;  $\text{H}_2\text{O}$ , 500 c.c.;  $\text{SnCl}_4$ , 0.5 g.;  $\text{CuCl}_2$ , 1.0 g.;  $\text{Fe}_2\text{Cl}_6$ , 30 g.;  $\text{HCl}$ , 50 c.c.

Humfrey:<sup>12</sup> Emery paper finish may be used for specimens. Copper ammonium chloride, 120 g.;  $\text{HCl}$  (concentrated), 50 c.c., more or less,  $\text{H}_2\text{O}$ , 1,000 c.c. The addition of  $\text{HCl}$  causes the copper deposit to adhere. Etching is therefore started with the neutral solution and continued until all traces of the scratches have disappeared. Then in successive applications the acidity of this solution is gradually increased up to the maximum. Alloy steels etch better with solutions of weaker acidity. After wiping away the deposited copper and drying, the surface is lightly rubbed with fine emery paper and the relief portions brought out in strong contrast. The selection may be printed with ordinary printer's ink applied to the surface by means of a roller.

Dickenson:<sup>13</sup> First etch with 10 per cent  $\text{HNO}_3$ . Then re-etch with  $\text{Fe}_2\text{Cl}_6$ , 40 g.;  $\text{CuCl}_2$ , 3 g.;  $\text{HCl}$ , 40 c.c.;  $\text{H}_2\text{O}$ , 500 c.c.

#### METHODS FOR INDICATING DISTRIBUTION OF SULPHUR

The distribution of sulphur is usually shown by the sulphur print method.<sup>14</sup> A solution of 2 to 3 c.c. of concentrated  $\text{H}_2\text{SO}_4$  in 100 c.c. of water is used to moisten a sheet of matt-finish photographic paper. The specimen with its surface smoothed either with a fine file or grinding wheel is pressed firmly on the paper on which a brown mark indicates the sulphur-rich areas. About sixty seconds is usually sufficient. The paper is then washed and fixed in hyposulphite solution.

With larger sections the paper is placed on their polished surface with care so that no air pockets occur. If a very dilute solution is used and a longer "etch" several prints can be obtained. Fresh solution can be added with absorbent cotton should the paper tend to become dry.

Considerable differences of opinion have arisen as to the meaning of the results obtained by deep etching in transversely fissured rails, etc., because the presence of cracks in the material previous to etching had not been demonstrated. The following method, however, can be used to locate them. The sample after careful polishing is magnetized and then immersed in kerosene or a

similar liquid containing very fine iron dust in suspension. The particles of iron dust collect upon the face of the specimen and orient themselves to correspond to the shape of the cracks because of discontinuity in the metal which causes a change in the density of the magnetic flux. The samples are then washed in clean kerosene to remove as much as possible of the excess iron dust which clings to the surface.<sup>15</sup>

According to several authorities their existence has been proved by annealing the specimens prior to etching, because a pronounced decarburized area then occurs around these cracks.

The camera should be arranged so that the specimen is illuminated by vertical light. After certain kinds of etching, e.g., ammonium persulphate, the surface should be immersed in water, alcohol or light oil. Large specimens may be covered with oil or glycerin.

The surface obtained by deep etching may be printed with printer's ink applied with a roller. The printing can be done on a glossy paper in a letter press. For small samples of wrought iron deeply etched a reproduction can be made using an ordinary ink pad and applying the specimen as in block printing.

#### The Condensation of Water Solutions of Furfural With Aniline

BY JACK P. MONTGOMERY AND E. S. ERNST

In a recent paper by Mains and Phillips<sup>1</sup> a resin, "furfur-aniline," was described and the optimum conditions for its production and application as a varnish stain were given. They used equal weights of furfural and aniline heated for one hour at 200 deg. C. in an open flask, or for three hours at 170 deg. C. in a flask attached to a reflex condenser. A gum which was hard and brittle at 25 deg. C., insoluble in water, soluble in benzene and in furfural was obtained. The saturated benzene solution gave a light brown stain on white oak and the saturated furfural solution a dark brown stain.

We have found that water solutions of furfural as dilute as 2 per cent, mixed with aniline and heated to 125 deg. C. in an autoclave for fifteen minutes, give a gum very similar to that described by Mains and Phillips, the chief difference being that the gum made by us gives a darker shade than that described by them.

When an excess of aniline is used with the solutions of furfural, the residue is oily and not brittle at 25 deg. C., but when the mixture is steam-distilled the excess aniline is separated and the residue is hard and brittle at 25 deg. C.

The preparation of water solutions of furfural is very easy, but the fractionation of the furfural is somewhat difficult<sup>2</sup> and there is always a considerable percentage, frequently up to 8 and 10 per cent, of furfural in the rejected water, according to our experience. If the furfural production is being carried on with a view to subsequent condensation with aniline, it would seem useless first to prepare pure furfural. If furfural is being prepared for other purposes, the rejected water from the fractionating process has enough furfural present to make its recovery as furfur-aniline profitable.

Department of Chemistry and Chemical Engineering,  
University of Alabama.

<sup>1</sup>Rawdon and Epstein, Technologic Paper 165, Bureau of Standards, 1920.

<sup>2</sup>CHEM. & MET. ENG., vol. 24, p. 661, (1921).  
<sup>3</sup>J. Ind. Eng. Chem., vol. 13, p. 133 (1921).

<sup>7</sup>Stead, *Journal, Iron and Steel Inst.*, 1915, vol. 1, p. 173, 1918, vol. 1, p. 408.

<sup>8</sup>Le Chatelier and Lemoine, *Compt rend.*, 1915, vol. 161, p. 373.

<sup>9</sup>Rosenhain and Haughton, *Journal, Iron and Steel Inst.*, 1914, vol. 1, p. 505.

<sup>10</sup>Le Chatelier and Dupuy, *Revue de Metallurgie*, vol. 15, p. 127.

<sup>11</sup>Oberhoffer, *Stahl und Eisen*, 1916, vol. 36, p. 798.

<sup>12</sup>Humfrey, *Journal, Iron and Steel Inst.*, 1919, vol. 1, p. 273.

<sup>13</sup>Dickenson, *idem*, p. 294.

<sup>14</sup>R. Baumann, *Metallurgie*, 1906, p. 416. Stead, "Sulphur and Iron," *Staffordshire Iron and Steel Institute*, March, 1908. Hatfield, "Cast Iron," p. 71, shows sulphur prints of pig iron.

## Effect of Lightning Striking an Acid Tank

BY PHILIP DE WOLF

AT 3:45 p.m. June 1, 1920, during a terrific rain storm, at the Old Hickory Powder Plant, now being developed by the Nashville Industrial Corporation, a 20 x 12 ft. vertical acid tank, containing about 200 tons of 89 per cent  $H_2SO_4$ , was struck by lightning.

The 20 x 12 ft. tanks are arranged in pairs, 60 ft. from the nearest building, high enough above the

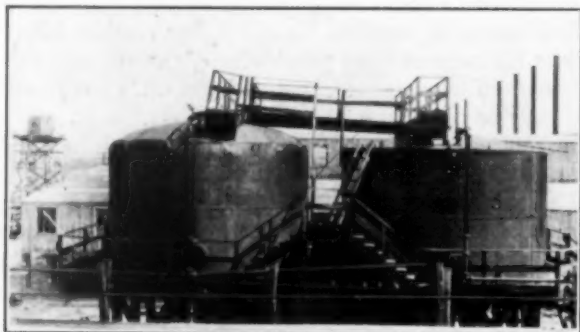


FIG. 1. ACID TANK STRUCK BY LIGHTNING

ground to feed by gravity to the circulation and storage tanks of the adjoining O. V. lines. At their closest point the tanks are only 3½ ft. apart. They are connected by overhead lines into the general acid system of the plant.

After the lightning stroke the acid began to pour out, and the fire department was called. Its activity was confined to flushing back the acid and confining it to the relatively small area about the tanks, where it was partly removed by the sewerage system, and partly absorbed by the sandy soil.

The tank had bulged at the top, wrecking the platform, and smashing some of the timbers in the main deck. The platform under the valves on the pipe line a hundred feet away was also wrecked, but no harm was done to the columns or foundations of the tank, outside of a little blackening of the wood due to carbonizing with acid.

The lightning naturally struck the tank at the top, but it was bulged out, not in, showing internal pres-



FIG. 2. TOP OF TANK, SHOWING DISTORTION

sure of considerable magnitude. This must have come from an accumulation of hydrogen inside, due to the action of the acid upon the iron, and this, with the air inside, exploded to water. Or possibly the heat vaporized enough of the acid to produce this pressure. While no temperature measurements were taken, the condition of the top of the tank, which is now coated with

a smooth oxide, apparently impervious to weather, shows that there was sufficient heat to start an explosion.

The top of the tank was bulged out 9 in. and all cast-iron fittings broken, but not a rivet was started, nor apparently a seam opened. The illustration shows the curious distortion of the top, how much more the plates were expanded than the single riveted lap joints.

The acid ran out only through the broken fittings.

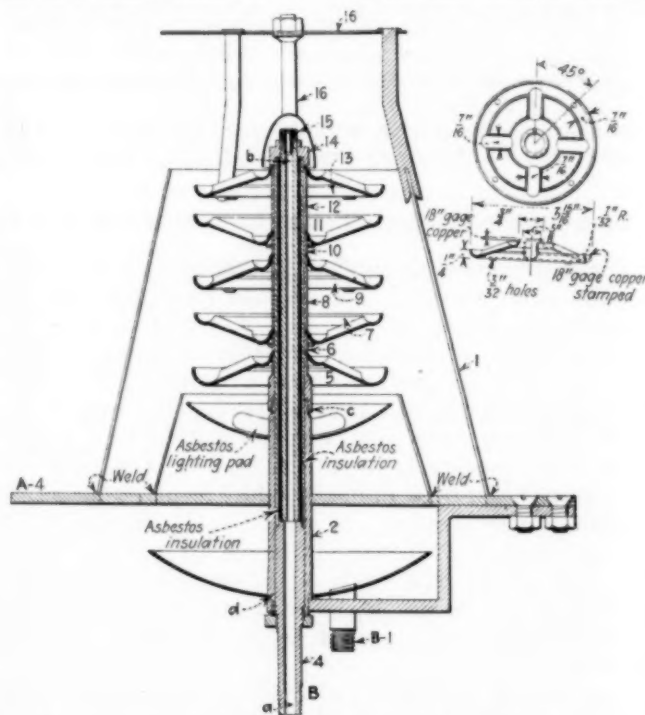
The lower half of the tank still retains its original coat of paint, all around, showing that the high temperatures did not get down that far; presumably the plates cooled very fast on account of the rain and the large body of acid inside.

But the course of the lightning was not the shortest way to the ground, over the tank and down the wet wooden columns, but along a horizontal 3-in. pipe line for a hundred feet, where instead of following the line any further it jumped 12 ft. to the ground, wrecking the platform there.

Why it did not touch the big tank only 3½ ft. away is a mystery, as is also the fact that several acid pipe lines, paralleling the one it chose for a path, and as near as 4 in. to it, were not touched.

## A New Development in Oil Burners

The early types of vaporization oil burners have been designed on the principle of boiling the oil indirectly and mixing the hydrocarbon vapors with air in the combustion zone. Carbon has always formed



troublesome deposits which were conducive of bad burner adjustment and incomplete combustion. Recently Dr. J. B. Garner, J. B. Anderson, G. A. Shaner and the staff of the National Gas Fellowship at the Mellon Institute of Industrial Research, Pittsburgh, have perfected a burner of novel design which gives promise of making 30 to 40 deg. Bé. distillate a first-class fuel at a price equivalent to 35c. gas.

The Peoples National Gas Co., the local branch of the donor of the fellowship, plans to exploit the burner, being influenced by the need of the conservation of its natural gas resources.

The essential feature of the design may be seen from

the cross-section of the burner given herewith. The oil is boiled by direct partial combustion during flow in the channel rings, producing a very hot vapor which is mixed with air under 0.5-oz. pressure in the combustion zone and completely burned. A very efficient flame results, an actual heat absorption of 56 per cent being obtained in commercial operation during a rise from 60 to 300 deg. F. The burner is lighted at an asbestos wick placed in the drip pan in the cone base.

The past year has been spent in demonstrating the practicability of this apparatus. When all serious imperfections in the apparatus had been removed by the inventors, it was submitted to the Underwriters' Laboratories, Inc., of Chicago, for inspection and test. These investigations were begun in July, 1920, and continued until January, 1921, when the approval and indorsement of the Fire Council of the National Board of Fire Underwriters was given.

## The Jennings Steam-Turbine-Driven Return-Line Heating Pump

THE satisfactory performance of the Jennings Hytor vacuum heating pumps, operated by electric motors, has led the Nash Engineering Co. of South Norwalk, Conn., to develop a novel type of steam-turbine-driven return-line heating pump. The cross-section (Fig. 1) shows the general design of this unit, which consists of an air pump that exhausts the air from the system, a centrifugal pump to remove the hot condensate and return it to a feed-water heater or hot well, and a steam turbine to drive the unit; all mounted on one shaft and assembled in the same casing.

The Jennings turbine-driven unit is especially designed for use in connection with heating or drying systems where the pump is called upon both to maintain a vacuum on the heating system and to return the hot water and condensation against a pressure.

The unit consists of two independent turbine pumps built in one casing—one pump handling the air, the other the condensation, the air and condensation being separated in a receiver under vacuum before entering the unit. This arrangement makes possible the large saving in horsepower, because the condensation, which is only one-eighth of the volume handled, is alone delivered against discharge pressure, the air being delivered free to the atmosphere. Also the air is handled in a

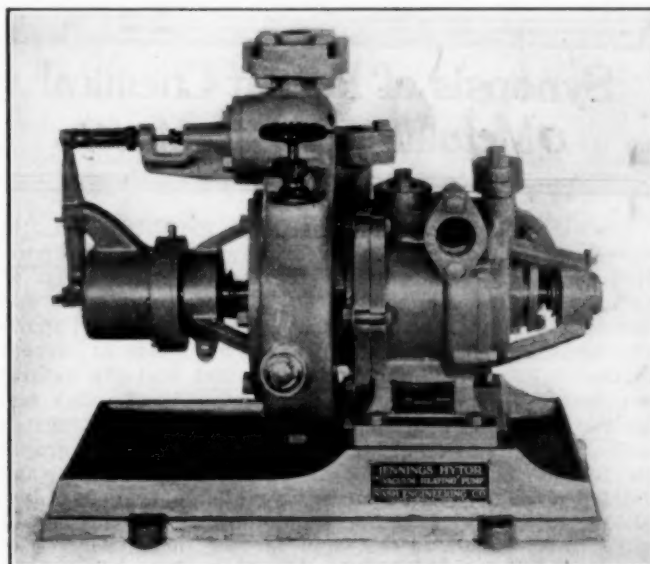


FIG. 2. STEAM-TURBINE-DRIVEN RETURN-LINE HEATING PUMP

pump designed for air, while the water is handled in a pump designed for water. This permits a much higher efficiency than in one pump handling both air and water.

The air end of the new turbine-driven unit is a development of the well-known Hytor vacuum pump, in which the rotor, the only moving part, revolves in an elliptical casing filled with water. The water turns with the rotor, but follows the casing, due to centrifugal force.

The water end of the machine is a centrifugal pump with an inclosed type impeller designed to give high efficiency when handling hot water. It has the very desirable characteristic of unloading when not handling condensation, and at the same time will require very little increased power when delivering against low heads. Provision has been made by special construction to vent the centrifugal inlet back to the receiving tank, which is under vacuum, precluding air binding.

All interior parts of the pump are constructed of bronze with the exception of the steam turbine rotor. No lubricant is required in the interior of the pump. No oil or grease can be introduced by the pump into the condensate. As the condensate is usually returned to a hot well, tank or feed-water heater for boiler feed purposes, this feature is very desirable.

The shaft upon which the impeller, rotor and steam turbine wheel are mounted is supported by the highest grade annular ball bearings mounted outside of the casing, in an adjustable housing. These bearings, if properly lubricated, will wear indefinitely.

The steam turbine rotating element consists of a solid steel forging with blades milled out off the rim.

A centrifugal throttling governor is furnished assembled as regular equipment to maintain a constant steam turbine speed. This governor automatically shuts off steam if the steam pressure rises or if the pump unloads when not handling condensation, preventing all increase in speed.

The turbines are designed to operate at 75 lb. steam pressure, although the turbine casing is suitable for steam pressures up to 200 lb. If it is desirable to operate at pressures lower than 75 lb., a satisfactory operation can be secured on pressures as low as 40 lb.

These pumps are ready for delivery in sizes up to 300,000 sq.ft. of equivalent direct radiation.

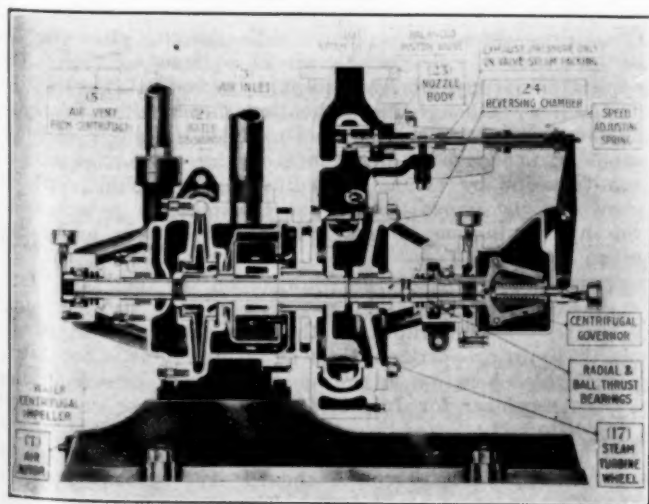


FIG. 1. CROSS-SECTION OF JENNINGS TURBINE-DRIVEN UNIT

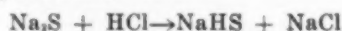
## Synopsis of Recent Chemical & Metallurgical Literature

**Chemical Research in India.**—Dr. E. R. Watson, in charge of the Government Research Institute at Cawnpore, India, discusses chemical research for the development of industries in India in the *Journal of Indian Industries and Labour* for May, 1921. He points out a number of important manufactured articles which are not made at present in that country, notwithstanding the fact that the natural raw materials are present in abundance. Among such materials and articles are mentioned: zinc, copper, tungsten and other ingredients of high-speed steels, chromium, graphite, thorium salts for gas mantles, caustic soda, benzene and related products, rubber goods, tin plate, paper, drugs, dyes and essential oils. It is remarked that "in the absence of any means for production from purely Indian sources of sulphuric, nitric and hydrochloric acids and the alkalis, our manufactures, actual or prospective, of paper, drugs, matches, oils, explosives, disinfectants, dyes and textiles are dependent upon imports, which under war conditions might be cut off, yet sources of raw materials for heavy chemicals are not deficient."

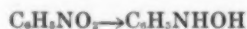
The quantity of coal tar available at present in India is not sufficient to supply a large byproducts industry; about 500,000 tons of coke and 8,000 tons of tar are produced annually. Her production of coal is now 20,000,000 tons, which would indicate that the output of coke can be increased materially.

The Indian Government is interesting itself in a proposal to erect zinc-smelting works at Jamshedpur to handle zinc concentrates from Burma. The plant under consideration will deal with 25,000 tons of concentrate annually, producing 10,000 tons of spelter and 32,000 tons of sulphuric acid. This is practically equal to the consumption of sulphuric acid, practically all of which at present is imported.

**Reduction By Sodium Hydrosulphide.**—In two papers in the June number of the *Journal of the Chemical Society* ("Reduction of Emulsified Nitro-Compounds, Part I. Phenylhydroxylamine From Nitrobenzene," by Arthur Lapworth and Lenore Kletz Pearson; pp. 765-768; "Part II. Some Extensions of the Method," by Robert Downs Haworth and Arthur Lapworth, pp. 768-777) is described a method of reduction of nitro-compounds of great theoretical interest and of probable commercial value. The active reagent is sodium hydrosulphide (NaHS) in aqueous solution, prepared by acidifying sodium sulphide with the requisite quantity of hydrochloric acid.



The reduced compounds desired are the substituted hydroxylamines.



The sodium hydrosulphide acts as the reducing agent. As practically all nitro-compounds are insoluble in water, it was deemed necessary to emulsify the nitro-compound (liquid) or to dissolve it in a solvent like benzene or toluene (solid compounds) and emulsify the solution. Calcium chloride proved a very satisfactory emulsifying agent, as its addition caused the precipitation of a finely-divided precipitate of calcium hydroxide or "basic" calcium sulphides, in the presence of which emulsification readily occurred. Furthermore, the concentration of hydroxyl ions was probably regulated by the calcium ions present, so that the reduction proceeded chiefly in the direction desired. By regulating the concentration of the solutions it was possible to obtain the phenylhydroxylamine crystallized out from the solution at the end of the reaction. The crystals were contaminated by the precipitate of calcium compounds which catalyzed the oxidation of phenylhydroxylamine (to nitroso-benzene) by the air when filtered. This was minimized by adding ammonium chloride at the end of the reaction to dissolve the calcium compounds and filtering

off the relatively pure phenylhydroxylamine. On a large scale the ammonia could be recovered from the mother liquors, or probably better still, hydrochloric acid could be used to dissolve the calcium precipitate. As the reaction mixture absorbs oxygen from the air rather rapidly, the reaction would best be carried out in a closed vessel to reduce this oxidation.

Yields of 72 to 74 per cent of  $\beta$ -phenylhydroxylamine from the nitrobenzene used were obtained without counting what was left in the mother liquors and might be recovered in a continuous commercial operation. The raw materials, nitrobenzene, calcium chloride or hydrochloric acid, are sufficiently cheap to be used as commercial raw materials for the process if sufficient use for phenylhydroxylamine could be found.

*p*-chloronitrobenzene gave 68 per cent of the theoretically possible *p*-chlorophenylhydroxylamine.

*p*-bromonitrobenzene gave 65 per cent of the theoretically possible *p*-bromophenylhydroxylamine.

*p*-iodonitrobenzene gave 64 per cent of the theoretically possible *p*-iodophenylhydroxylamine.

*p*-nitrotoluene in benzene gave 53 per cent of the theoretically possible *p*-tolylhydroxylamine and a further 5 per cent could be extracted from the mother liquors.

*o*-nitrotoluene gave 15 per cent of the theoretically possible *o*-tolylhydroxylamine, which, however, did not separate out as such, but was estimated by oxidation to *o*-nitrosotoluene.

*o*-chloronitrobenzene gave 62 per cent of the theoretically possible *o*-chlorophenylhydroxylamine, which was not isolated as such, but was oxidized to *o*-chloronitrosobenzene, a new compound.

*m*-bromonitrobenzene gave 55 per cent of the theoretically possible *m*-bromophenylhydroxylamine.

*m*-chloronitrobenzene gave 57 per cent of the theoretically possible *m*-chlorophenylhydroxylamine.

$\alpha$ -nitronaphthalene gave close to 80 per cent of  $\alpha$ -naphthylhydroxylamine. By using an excess of sodium hydrosulphide, and kieselguhr instead of calcium chloride (as calcium chloride emulsions break down on heating) and heating on water bath for eight hours, 73 per cent of theory of  $\alpha$ -naphthylamine was obtained. At lower temperature with calcium chloride not a trace of  $\alpha$ -naphthylamine was obtained.

$\alpha$ -nitroanthraquinone yields more than 80 per cent of theory of  $\alpha$ -aminoanthraquinone or 73 per cent of theory of  $\alpha$ -hydroxylaminoanthraquinone, depending on conditions of experiment.

*m*-dinitrobenzene gave 3:3' dinitroazoxybenzene and 2:4 dinitrotoluene gave 3:3'-dinitro-4:4'-dimethylazoxybenzene as the partial reduction products.

Nitroanilines reduced by this method do not stop at the hydroxylamine stage, but reduce completely to the diamine stage.

*p*-nitrophenol gave no reduction products by this method.

(The abstractor may record that it is his experience that calcium chloride is a useful catalyst in reductions of nitro-compounds. Thus, *p*-nitraniline is almost quantitatively smoothly reduced to *p*-phenylenediamine by zinc dust in the presence of calcium chloride in aqueous solution. The application of sodium hydrosulphide to reductions is by no means new, although its application to emulsified insoluble nitro-compounds is original and useful. Hundreds of thousands of pounds of *m*-dinitrobenzene have been reduced to *m*-nitraniline by means of sodium hydrosulphide, but, as shown in the paper quoted, the intermediate reduction to the hydroxylamine is impossible in this case under the given conditions.)

**Proof Loads.**—After remarking upon the fact that many engineering materials do not possess any "yield point" when testing in tension and that the determination of the elastic limit, proportional limit or fatigue limit is not now a practicable operation in routine testing, an editorial writer in the *Engineer* for July 8, 1921 (p. 42), goes on to say:

"Fortunately, a fairly satisfactory alternative exists and has been incorporated in some of the recent specifications of the British Engineering Standards Association. It is the specification of a 'proof load.' There may be some doubt as to the appropriateness of this particular term, but the idea itself appears to be entirely sound. It is based upon

the principle that, instead of endeavoring to ascertain in the course of a rapid tensile test at what particular stress permanent deformation occurs to a measurable extent, it is better to decide beforehand, as the result of accurate tests made by means of extensometers or otherwise, what stress satisfactory material of that particular type should be well able to bear without undergoing any extension more than a small specified amount, such as  $\frac{1}{2}$  per cent. If the figure thus arrived at is specified as the 'proof load,' it is a very simple matter to test any given specimen. All that need be done is to mark the test-piece accurately with two fine lines whose distance apart is the standard specified gage length; the specified 'proof load' is then applied to it for a specified short time and the load is then removed and the test-piece remeasured. If the lines marked on it have not moved apart by more than the specified amount— $\frac{1}{2}$  per cent—the test has been passed, and the breaking or ultimate stress, extension, etc., can then be determined by a further test on the same test-piece. It is all very simple and quick; measuring appliances, such as small microscopes, can easily be mounted so that the measurement can be made in a few seconds without removing the test-piece from the machine. Above all, however, is the great advantage that the manufacturer, the inspector and the engineer all obtain a definite determination which bears some relation to the properties of the material, instead of a vague estimate of a non-existent yield point."

## Recent Chemical & Metallurgical Patents

### American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

**Acid-Resisting Alloy.**—Foster Milliken, of Lawrence, N. Y., has prepared an alloy with a high resistance to corrosion by acids and capable of withstanding high temperatures. It is claimed to be serviceable for use in the manufacture of plugs and other still fittings. Its approximate composition is as follows: Copper, 45-55 per cent; nickel, 29-35 per cent; lead, 1-3 per cent; zinc, 5-9 per cent; iron, 4-8 per cent; and silicon-copper (approximately 10 per cent) 1-3 per cent. (1,377,089; assigned to Foster Milliken, S. F. Deaver, and James M. Repplier, trustees; May 3, 1921.)

**Manganese-Magnesium Alloy.**—Magnesium and manganese, when heated together, do not ordinarily alloy to an appreciable extent except at temperatures above the boiling point of magnesium. If, however, there is an inter-fusing of a limited amount of a manganese compound, such as manganous oxide or chloride, with an excess of magnesium, it is possible to obtain an alloy of manganese with magnesium in the proportion varying from 0.5 to 8.0 per cent. These alloys, with specific gravity of less than 2, have an ultimate strength of more than 20,000 lb. per sq. in. when in the form of castings. (1,377,374; WILLIAM R. VEAZNEY, assignor to the DOW CHEMICAL Co., of Midland, Mich.; May 10, 1921.)

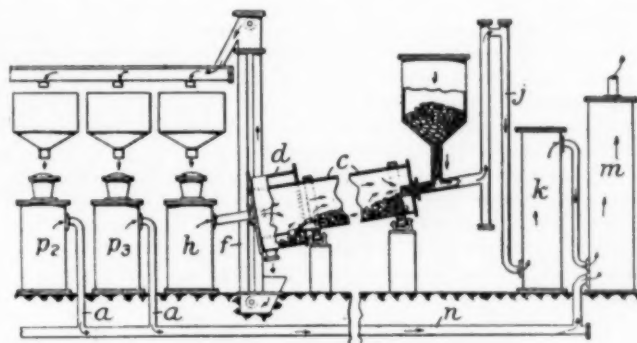
**Refining Sulphur.**—In the mining of sulphur in Louisiana and Texas, the melted sulphur is brought to the surface and diverted to wells or sumps, where it is permitted to cool and solidify. The solidified sulphur is then removed and broken into fragments of suitable size for shipment. The process is long and there is a considerable production of fines which are more or less undesirable. Raymond F. Bacon and Calvin H. Wenrich of Pittsburgh, Pa., have patented a substitute process by which the molten sulphur is converted into pellets and similar pieces of size and weight which may be uniformly controlled by the operator. This is accomplished by supplying the sulphur, at a temperature of 115 to 130 deg. C. in the form of drops into a solution of a salt, such as calcium chloride, in water. The solution contains sufficient salt to give it the required

specific gravity as well as a sufficiently high boiling point. (1,378,084; assigned to TEXAS GULF SULPHUR Co., Bay City, Tex.; May 17, 1921.)

### British Patents

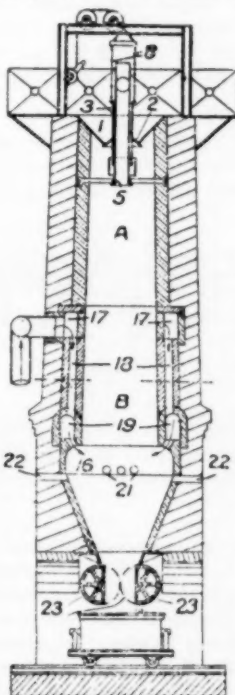
For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

**Gas Manufacture.**—In a plant for the distillation of carbonaceous material by contact with hot producer gas, a number of producers are used to consume the whole of the coke obtained, and only one producer delivers gas to the retort so as to avoid undue dilution of the coal gas prior



to the separation of tar oil. The coal is fed into a rotary retort *c*, and the coke is discharged through an annular casing *d* to a conveyor *f* feeding the producers *p2*, *p3*, *h*. The gas from the producer *h* passes through the retort to a condenser *j* and oil washer *k* and thence to an ammonia washer *m*, to which the gas from the auxiliary producers *p2*, *p3* is led directly by a main *n*. (Br. Pat. 162,459. H. Nielsen and J. R. Garrow, both of London; June 22, 1921.)

**Refuse-Consuming Furnace.**—A vertical shaft refuse destructor comprises a device for collecting the noxious fumes, etc., means for heating air for combustion, and improved discharging means. The hopper 1 is closed by a cone-valve 2 mounted on a movable sleeve 3 operated by chains 8. Concentric with the sleeve 3 is a tube 5 serving as an escape flue for fumes and distillation products. Refuse is distilled and dried in the upper zone *A* and is then consumed in the lower zone *B* with air which is heated in two annular passages 17, 19 and vertical ducts 18 and downwardly discharged by orifices 16 into an enlarged cone-shaped lower portion of the shaft. The residue is discharged by segmental drums 23 consisting of hollow air-cooled disks mounted on horizontal rotatable shafts. Orifices 21, 22 admit steam jets or other means for disintegrating the clinker. Flames escape by a suitable duct and may be used for steam generation etc. (Br. Pat. 162,597. H. Breuille, Paris; June 22, 1921.)

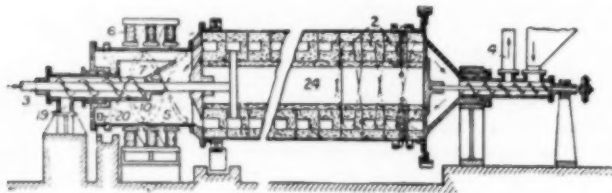


**Arsenical Compounds.**—Salts of thioarsenic acids, possessing the general formulæ  $\text{RAsO}_3\text{--}_x\text{S}_x$  and  $\text{RAsO}_4\text{--}_x\text{S}_x$  in which *R* represents an alkali metal, ammonium or an organic ammonium radicle, are prepared by passing sulphuretted hydrogen into a solution of an arsenate, or by treating arsenious oxide or arsenic trisulphide with an alkali or ammonium polysulphide, or by treating arsenic pentasulphide with an alkali or ammonium monosulphide, followed by double decomposition in the case of the organic compounds. Examples are given of the preparation of  $\text{Na}_3\text{AsO}_3\cdot\text{S}\cdot 12\text{H}_2\text{O}$ ,  $\text{Na}_3\text{AsO}_3\cdot\text{S}_2\cdot 10\text{H}_2\text{O}$ ,  $\text{Na}_3\text{AsO}_3\cdot\text{S}_3\cdot 10\text{H}_2\text{O}$ ,  $\text{Na}_3\text{AsS}_4\cdot 8\text{H}_2\text{O}$ ,  $\text{NaAsS}_3$ , and of the analogous salts of methyl-

amine and ethylamine. The substances are of use for the destruction of parasites externally. (Br. Pat. 162,747. K. B. Edwards, London; June 29, 1921.)

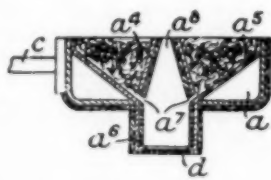
**Casein Composition.**—Casein is treated with formaldehyde, dried and shaped under heat and pressure. The casein may be coarsely or finely ground and moistened with a solution of formaldehyde, or the unground casein may be soaked in the solution. The drying is preferably continued until no trace of free aldehyde remains. The material is moulded at a temperature above 90 deg. C. and a pressure exceeding 100 atmospheres. (Br. Pat. 162,657; not yet accepted. E. Krause, Berlin, and H. Blücher, Leipzig; June 22, 1921.)

**Treating Poor Iron Ores.**—In the treatment of poor iron ore containing weakly magnetic or non-magnetic oxygen compounds of iron by subjection to a reducing roast at about 400 deg. C. to facilitate magnetic separation, the concentration is effected while the material is still in the reducing atmosphere. The ore is fed to helical channels 2 in a rotary furnace having a central heating-passage 24. Hydrogen is supplied to the channels through a pipe 3, and the gaseous products escape through a pipe 4 to a condenser. The magnetic separator comprises a cylinder 5 which rotates with the furnace, and is partly surrounded by a system of magnets 6. Helical ribs 10 convey the material into the magnetic field, and the particles attracted to the surface are



carried to the top, fall into a stationary pocket 7, and are conveyed to an outlet 19; non-magnetic particles are discharged through an opening 20. In a modification, the separation is effected in the furnace itself, and the magnetic and non-magnetic particles after separation are conveyed automatically into one or other of the two helical channels. The reduction of the magnetic material may be completed, and the product melted in an electric or other furnace. (Br. Pat. 162,718. R. Stören and R. Johanson, both in Norway; June 29, 1921.)

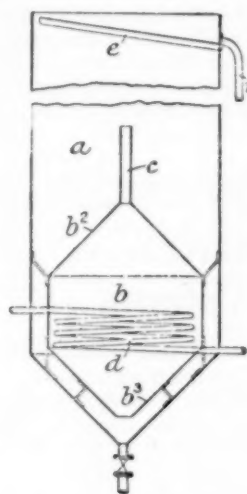
**Recarburizing Steel.**—A means for recarburizing molten steel in an open-hearth furnace consists of a box *a* which is carried on a ram *c* and fitted with hopper-like plates *a*<sup>4</sup>, *a*<sup>5</sup>, to contain the carbonaceous material, and provided with an extension *a*<sup>6</sup> to pass through the slag. The extension is temporarily closed by a cover, such as a wooden plug *d*, adapted to be melted or consumed in the molten steel. The openings *a*<sup>7</sup> between the plates and the extension are temporarily closed with paper stoppers, and a vent *a*<sup>8</sup> is provided to allow the escape of gas generated during the operation. (Br. Pat. 162,994. J. N. Kilby, Rotherham, and N. H. Bacon, Sheffield; June 29, 1921.)



**Making Tungsten Wire.**—In making tungsten wire, particularly for electric-lamp filaments, a blank consisting of rods which contain or are bound together to produce in their cross-section zones differing from one another as regards their composition in physical properties is drawn and then submitted to a heat-treatment so that the crystals form uniformly along the length of the wire. The length of the crystals in the direction of the axis of the wire exceeds the diameter of the wire several times. The blank may differ in composition from the axis to the circumference or from side to side, or may contain different sectors. The blank may consist of a casing into which circular, rectangular or other structures of desired composition are inserted, the casing or core consisting of pure tungsten, tungsten and thorium oxide, or tungsten alloyed with metals or metalloids such as molybdenum, manium, thorium, tantalum, vanadium,

chromium, carbon or phosphorus or mixtures or compounds thereof or with other elements dissolved or admixed therewith. As examples, the casing may consist of pure tungsten and the core of tungsten containing thorium dioxide, or the casing may be of tungsten containing thorium dioxide and the core of pure tungsten or tungsten containing a small quantity of thorium dioxide. The thorium oxide, etc., may be introduced into the blank by superposing or imbedding or introducing into holes in the blank layers of powder, by inserting sintered or mechanically worked bodies or by saturating with solutions. The wire may be regularly heated throughout its whole length or may be heated by passing the wire through a hot zone. The latter method may be effected by heating sections of the wire in turn by an electric current or by surrounding with a hot cylinder or ring. (Br. Pat. 163,014; not yet accepted. Patent Treuhand Ges. für Elektrische Glühlampen, Berlin; June 29, 1921.)

**Separating Water From Coal Tar.**—Water is separated from coal tar by projecting the tar upwardly against a



separating surface to which the water adheres and from which it is collected. A vessel *a* is provided with a container *b* having conical ends *b*<sup>2</sup>, *b*<sup>3</sup>, the end *b*<sup>2</sup> preferably having a tube *c* and the end *b*<sup>3</sup> being open to the vessel *a*. The vessel *a* is filled with tar which enters and is heated by a coil *d* in the container *b*, and the tar is projected upwardly against an inclined separating plate *e*, the water adhering to the under surface of the plate and traversing along until it creeps over the upper edge. A drain pipe *f* is provided above the lower end of the plate *e*. (Br. Pat. 163,011; not yet accepted. Bismarckhütte, at Bismarckhütte, Upper Silesia; June 29, 1921.)

**Cellulose and Other Carbohydrate Ethers.**—In the production of ethers of cellulose, starch, dextrine, etc., their conversion products and derivatives, the cellulose, etc., is before reaction with the alkylating, aralkylating or arylating agents, treated with solid caustic alkali either in the dry state or in the presence of so little water or caustic alkali solution that at least a part of the caustic alkali remains undissolved; the products—films, celluloid, artificial filaments and insulating materials—prepared from the ethers eventually obtained, are distinguished by their water-resisting properties. The incorporation of the cellulose, etc., with the caustic alkali may be conducted in the presence of air or inert gas, or in vacuo, and at ordinary temperatures, or with heating or cooling; and the treated cellulose may before etherification be freed wholly or partly from the water contained therein, and may be immediately treated with the alkylating, etc., agent, or after standing. The etherification may be conducted so as first to form a lower ether, which may be converted into a higher ether by treatment with further quantities of caustic alkali and alkylating etc. agent. (Br. Pat. 163,018; not yet accepted.—See also 163,016 and 163,017.—L. Lilienfeld, Vienna; June 29, 1921.)

**Calcium Nitrate.**—Calcium nitrate is obtained from nitric acid obtained from atmospheric nitrogen by concentrating the acid to about 48 deg. Bé. and supplying ground calcium carbonate (limestone) and the concentrated acid continuously to an apparatus in which the temperature is not allowed to rise above the boiling point of the acid, 60 to 80 deg. C. being mentioned. The apparatus may consist of a horizontal tube having a conveying screw which discharges the calcium nitrate in a pasty condition. The carbonic acid is withdrawn under reduced pressure at the end at which the reagents are supplied. (Br. Pat. 163,330; not yet accepted. Aluminum Industrie Akt. Ges., Neuhausen, Switzerland; July 6, 1921.)

## Current Events

### in the Chemical and Metallurgical Industries

#### Chemical Schedule Considered

After closing the public hearings on the dye embargo, the Finance Committee of the Senate began listening to testimony in regard to the various items in the chemical schedule and items on the free list which would fall within that schedule if made dutiable.

Producers of salt told the committee that after many years, during which no efforts were made to import salt, large quantities now are arriving at north Atlantic ports from Germany. Due to lower producing costs and to low ocean rates, salt from Germany is being offered at Atlantic ports at 29c. per 100 lb., it was testified. This is less than the average freight rate from the mines in New York State. The Fordney bill carries a duty of 7c. per 100 lb. This is held by the domestic producers of salt to be entirely inadequate. They ask for a duty of 15c. per 100 lb., plus an ad valorem rate of 20 per cent. The ad valorem rate is contingent upon American valuation.

The National Association of Glue and Gelatin Manufacturers appeared to ask for a segregation of glue and gelatin. It was pointed out that gelatin is a much higher-grade product than glue and should not be grouped with it under one bracketing and rate. The association of glue and gelatin manufacturers has asked that paragraph 39 of the bill be corrected so as to read:

Glue, and glue size, 20 per cent ad valorem and 1½c. per lb.; manufactures, wholly or in chief value of glue, cascin glue, isinglass and other fish sounds, cleaned, split or otherwise prepared, and agar agar, 25 per cent ad valorem. Gelatin conforming to United States pure food laws specifications, 20 per cent ad valorem and 7c. per lb. Technical gelatin, gelatin in sheets, or otherwise, with physical qualities to show a solidified jelly in mixture of 1.8 g. of gelatin to 100 c.c. of water at 42 deg. F., for six hours, valued above 30c. per lb., 20 per cent ad valorem and 15c. per lb. Manufactures, wholly or in chief value of gelatin, 35 per cent ad valorem.

August Kochs, president of the Victor Chemical Works of Chicago, addressed the committee with regard to oxalic and formic acids, asking that a specific duty of 5c. per lb. be allowed in addition to the 25 per cent ad valorem rate contained in the bill passed by the House. He said the American industry has been struggling to live for fifteen or eighteen years and that the rate of duty asked is necessary for the continuation of the industry.

Don D. McCloud, representing the Gas Products Association, which is composed of forty manufacturers of oxygen, appeared to protest against a duty of \$20 a ton on calcium carbide.

Matthew Adgate, representing the Naugatuck Chemical Co., of Naugatuck, Conn., protested against a rate of 6c. per lb., and 30 per cent ad valorem on acetaldehyde and paracetalddehyde. He pointed out that these chemicals are not manufactured in the United States and are important in the rubber industry.

R. L. Hoguet, president of the Antimony Compounds Co., of New Brunswick, N. J., told the committee that the Fordney bill rates of 2c. on antimony oxide and 1½c. on antimony are inadequate. He suggested that a duty of 4c. on each would be necessary in order to equalize the lower labor costs in China.

John H. Keusel, of Tenaflly, N. J., president of the Meadows Oil & Chemical Co., asked that the Fordney bill be revised so as to protect American manufacturers against synthetic ammonium ichthyolate.

J. G. Timolate, representing the Oakland Chemical Co., New York, urged the committee to remove the duty on crude barytes or at least not to allow it to exceed \$2 per ton.

A representative of the Commercial Solvents Corporation presented an argument in behalf of a duty of 20c. per lb. on amyl, butyl and isopropyl alcohols and fusel oil. These alcohols are made dutiable at 6c. per lb. in the bill passed by the House.

Nine manufacturers of epsom salts presented a brief and oral argument asking that 35 per cent ad valorem be added to the ½c. duty on epsom salts allowed in the Fordney bill.

Charles B. Grimes, representing importers of bone black, appeared in opposition to the 20 per cent duty contained in the House bill. He said it would prohibit all importations.

A representative of the Diamond Match Co. urged that phosphorus be put on the free list. The rate in the Fordney bill of 10c. per lb. will put the domestic match industry at the mercy of a company controlled in England, he said.

The committee on magnesite consumers, a representative of the American Refractories Co., of Pittsburgh, and a representative of an American company engaged in magnesite mining in Venezuela, presented arguments intended to convince the committee that crude magnesite should be put on the free list.

#### Bill to Stimulate Production of Mineral Raw Materials for Chemical Industry

With Congress prescribing particularly high rates of duty to foster the chemical industry, Representative Rhodes, chairman of the House Committee on Mines and Mining, believes the Government should undertake a comprehensive program looking to the stimulation of the production of non-metallic minerals from which the chemical industry draws much of its raw material. It is Mr. Rhodes' intention to concentrate his efforts toward getting such action. He is assured of the unanimous support of the Committee on Mines and Mining.

As the first step of this program, Mr. Rhodes has introduced the following bill:

That the United States Bureau of Mines be authorized and directed to carry on investigations as follows:

(1) To conduct inquiries and scientific and technical investigations in the United States and its territories concerning the mining, treatment and utilization of non-metallic minerals, such as sulphur, phosphate rock, feldspar, potash, mica, graphite, talc, barytes, limestone, and so forth, with the main object of elimination of waste both in their production and utilization.

(2) To conduct investigations for the purpose of aiding in the efficient production of the non-metallic and other mineral raw materials for the chemical industry, and to investigate and obtain fundamental data needed for the efficient production of chemical products from mineral sources.

Mr. Rhodes points out that no other industry was developed during the war to the same extent as was the chemical industry. A natural complement of tariff protection for the industry is the stimulation of the production of such domestic raw materials as that industry can utilize, Mr. Rhodes believes. He contends that the development of the non-metals has lagged far behind that of the metalliferous minerals. As evidence of that contention, Mr. Rhodes points to the action of Congress during the war in authorizing an appropriation of \$50,000,000 in an effort to stimulate the prompt production of a number of minerals then urgently needed for war purposes. Among them were about forty non-metals.

"Now that the war is over," he says, "we are content to settle back comfortably and allow ourselves to follow the line of least resistance and continue to buy our non-metals from foreigners. When the country needed these minerals most, we found that they were undeveloped. We have had our lesson. Now there is no excuse for our failure to achieve economic independence in practically all of the non-metals."

### The Muscle Shoals Situation

Since the defeat of the appropriation for continuation of the work on the Wilson dam there has been a feeling on the part of some of the friends of that project that the Muscle Shoals development is enmeshed hopelessly in politics and misunderstandings. There is a growing impression, however, that Henry Ford's proposition offers a way out. While several propositions were submitted in response to the request of the Chief of Engineers, there was but one practical proposal—that of Mr. Ford. The other propositions were indefinite and unaccompanied by any evidence that the persons submitting them commanded financial resources necessary to carry on the work.

J. B. Duke, president of the Southern Power Co., is understood to have expressed the opinion that the Government cannot complete the Wilson dam and the hydro-electric plant and obtain a reasonable return on the investment. His opinion, which is subscribed to by all the Southeastern hydro-electric companies except the Alabama Power Co., is understood to have been based on a report made by W. S. Lee, chief engineer of the Southern Power Co.

The Alabama Power Co. is not in a position to submit a bid at this time. Thomas W. Martin, president of the company, in reply to an inquiry by General Beach, Chief of Engineers, has explained the position of that company in a detailed statement.

It is believed that the business depression prevented some interests from submitting bids. Had times been better, much more interest would have been shown in General Beach's inquiry, it is believed. The inquiry was sent out widely to interests likely to be able to make use of this power. Some interests, it is stated, entered upon a systematic effort, when the appropriation failed of passage, to belittle the whole Muscle Shoals proposition. As a result, they were not in a position to reverse themselves by submitting bids.

Considerable criticism is reaching Washington as a result of the action of the Secretary of War in making public the Ford proposal. This gives an unfair advantage to other bidders, it is declared, and is contrary to the long-established policy of the War Department.

There can be no doubting of the widespread and growing public demand that the Ford offer be accepted unless some one else is willing to submit a better proposition at once. This is evidenced by the large number of letters which are being received from all sections of the country by Senators and Representatives. The publicity the matter has received has also had the effect of arousing new demands that the Government itself undertake the operation. Senator Underwood continues to insist that the operation of the project by the Government is the only way in which the public will receive the maximum benefit from this natural resource. It is believed that he will support legislation looking to the carrying out of the Ford proposal, or any other private proposal, only when he is convinced that the opposition has the votes to defeat Government operation.

Some letters are being received on Capitol Hill alleging that Mr. Ford is seeking this resource as a part of his plan to monopolize the farm tractor and cheap automobile fields. This charge, it may be said, is not regarded seriously by legislators, as it is generally recognized that such monopoly as Mr. Ford's products may enjoy has not been obtained by absorbing competitors, but by attaining costs so low that competitors are not able to compete.

### Byproduct Coke Oven Company Formed

The Belgian-American Coke Ovens Corporation, New York, has been formed with a capital of \$10,000,000, to construct and install Plette byproduct coke ovens and carbonization equipment for fuel saving. Olivier Plette, of Belgium, holds the patent rights to the coke ovens and appliances, and will be on the board of directors of the new organization, which is headed by Thomas F. Ryan and F. S. Landstreet, both of New York. The latter has been elected president of the company and offices have been established at 25 Broad St. The American corporation will have the assistance of technical experts from Belgium. The European organization is known as the Franco-Belgian Coke Ovens Corp.

### Salesmen's Association of American Chemical Industry

One hundred representative salesmen and sales executives connected with American manufacturers and their recognized sales agents in all branches of the chemical industry will be invited to become charter members of the Salesmen's Association of American Chemical Industry, after plans of the organization committee have been formed.

This committee, which consists of Fred E. Signer of Butterworth-Judson, chairman, Charles F. Abbott of National Aniline, John A. Chew of Warner Chemical Co., P. S. Tilden of du Pont, A. H. Pierce of Grasselli, E. J. Barber of The Barrett Co., E. C. Scott of Wing & Evans, and Williams Haynes of Drug & Chemical Markets, secretary, held a meeting Monday, Aug. 8, at which a constitution was drawn up. This constitution provides that the membership shall be open to any American citizen connected with the sales or advertising staff of an American chemical manufacturer, or his recognized sales agent, and vests the active control of the association in an executive committee, consisting of the officers and six members, two of whom shall be elected every year to serve three years and who shall be ineligible for re-election at the expiration of their term. The committee is considering plans for the promotion of local associations in the various large cities.

According to the present plans, invitations will be extended to one hundred thoroughly representative salesmen to join as charter members. Details are being considered for a meeting and dinner to be held at the time of the Chemical Exposition.

Salesmen interested in this organization, the object of which is to be the fostering and promotion of the commercial interests of the sales staffs and of the broader interests of the chemical industry as a whole, are requested to communicate with the secretary, 3 Park Place, New York City.

### Wants Organic Chemistry Encouraged

Senator Ladd, of North Dakota, appeared before the Senate Finance Committee as a witness to make a special plea for an American organic chemical industry. He classed the making of dyes as a master-key industry and declared that he would rather see a monopoly than to take any chances on destroying the start which the United States has made in the manufacture of dyes. Senator Ladd's statement to the committee follows:

I simply desire to come before the committee and record my interest in American organic chemistry and the chemical industry in this country. For nearly forty years I have been engaged as a researcher and chemist, and in chemical laboratories as a teacher. I have seen in the past the need of building up organic chemistry, which has not been made possible because of the fact that the Germans had apparently complete control of the manufacturing.

I feel that if England and France and Italy and Japan found it necessary to place an embargo on dyes for a certain length of time, those that are made in those countries, and to afford protection to those that are needed to build up, the United States ought to do the same thing. I do not feel that it is likely that a tariff, however high it may be placed, will enable the organic chemical industry of the country to develop as we hope for.

I have heard considerable and read considerable on the question of a monopoly in the dye industry. I doubt very much that that is true in any true sense of the word, but if there is to be a dye monopoly I would rather see it in the hands of American manufacturers, where they can be controlled by Congress and the American people, rather than in the hands of foreigners. I think we can render a distinct service at this time to chemistry and to the industries of this country by protecting the organic chemical industry and the dye industry, to furnish means of training our young men who are graduates of educational institutions in chemistry for work along the lines and in the lines necessary for development in this country. If we are to be drawn into another war at any time it seems to me that we will be in a very poor condition unless our organic chemistry and our institutions for manufacturing organic materials of all classes are well protected.

## Chemical Exposition Notes

### PUMPS AND CONDENSERS

Air pumps and condensers have not been overlooked at the chemical exposition this year. A most comprehensive exhibit has been planned as part of the annual show, which will be held in the Eighth Coast Artillery Armory, New York, Sept. 12 to 17. One company will display besides a double effect evaporator with circulating pumps and piping, a barometric ejector condenser, a centrifugal pump, Edwards air pump, and two steam jet air pumps, a model cooling tower tube exhibit.

Pumps for air, industrial gas or acid gas will be exhibited. A pump or compressor where no valves, gears, pistons, piston packing, sliding vanes or interior lubrication is necessary will be entered in one of the displays on this subject. Tank pumping installations, pumping systems, vacuum apparatus for all chemical purposes, dry vacuum, centrifugal, air compressors, acid, and hydraulic pressure pumps and deep well engines will be shown. Hard rubber pumps, pipe, fittings, tanks and utensils will form part of this most complete exhibition.

### International Conference at A. C. S. Meeting

The fall convention of the American Chemical Society will be opened by a general meeting to be held in the gymnasium of Columbia University, Wednesday, Sept. 7, at 10 a. m. Sir William J. Pope will speak and Herbert Hoover has promised to address the gathering provided public duties do not interfere.

On Thursday, Sept. 8, a joint international meeting will be held in the Great Hall of the College of the City of New York. Dr. Edgar F. Smith will preside. The following addresses have been announced:

"Science and Civilization; the Rôle of Chemistry," by Prof. Charles Baskerville.

"Energy; Its Sources and Future Possibilities," by Dr. Arthur D. Little.

"The Engineer; Human and Superior Direction of Power," by Dr. Leo H. Baekeland.

"Chemistry and Life," by Sir William J. Pope.

"Theories and Their Development," by Dr. Willis R. Whitney.

"Research Applied to the World's Work," by Dr. C. E. K. Mees.

"Problem of Diffusion and Its Bearing on Civilization," by Prof. Ernst Cohen, of the University of Utrecht.

"Catalysis; The New Economic Factor," by Prof. Wilder D. Bancroft.

Prof. Samuel A. Baldwin, head of the department of music of the College of the City of New York, will give an organ recital in honor of the delegates.

Following the sessions at Columbia University the chemists will attend the National Exposition of Chemical Industries, which is to be held from Sept. 12 to 17, inclusive, in the Eighth Coast Artillery Armory in the Bronx. At this exposition will be shown many new types of chemical apparatus and of machinery used in the large-scale manufacture of the products of industrial chemistry.

### Optical Society to Meet in Rochester

The Optical Society of America will meet in Rochester, N. Y., Oct. 24, 25 and 26 at the Hotel Rochester. Members and others desiring to communicate results in optical research are invited to submit titles any time before Sept. 25 to the secretary, Irwin G. Priest, Bureau of Standards, Washington, D. C. Because of the optical industries in Rochester it is expected that this will be a particularly interesting meeting. The local committee is arranging for visits to Bausch & Lomb and the Eastman Kodak Co.

### British Chemical Workers to Strike

According to a recent cable despatch from London, the executive committee of the Federation of Chemical Workers has rejected the employers' proposal to reduce wages 2d. per hour. The men propose to strike on Aug. 27. The Brunner Mond Co. threatens to close down its Winnington works unless sufficient men accept the reduced wage and agree to continue under the new scale.

### Alcohol Fumes Explode at Abbott Laboratories

The Abbott Laboratories, large manufacturer of synthetic pharmaceuticals, had a serious explosion in the process plant at 4753 Ravenswood Ave., Chicago, on Monday, Aug. 8. One of the operations involves the production of high proof alcohol in an apparatus consisting of a Stokes rotary vacuum drier, a dust trap and distillation column. The horizontal drier, 15 ft. long by 3½ ft. diameter, with steam jacket and horizontal agitating mechanism, receives the mixture of slaked lime and low proof alcohol through an opening on top. The gasketed cover is clamped down and steam introduced in the annular space about the mixing chamber. No vacuum was used at the time of explosion and the steam is introduced at such rate that no pressure registers on the gage.

Alcohol vapor passes over through the dust trap, which is a horizontal steel cylinder about 2 ft. in diameter by 4 ft. long equipped with baffles for catching any lime dust which may be mechanically carried in the vapor. From this point the vapor is carried upward through a pipe bend (about 8-in. pipe) into the top of the column. The agitating shaft is driven by a 15-hp. four-pole direct-current back-gear open electric motor, in turn controlled through an inclosed "Square D" knife switch and exposed starting box with release coil. All this apparatus is mounted on the frame at the end of the drier.

As near as can be determined the pipe bend between trap and column became clogged near the top of the still with lime dust, the dust trap having ceased to function. Pressure of entrapped alcohol and water vapor built up immediately in the inner chamber of the drier and began to leak into the room around the gasket at the feed opening. The operator, noting something was amiss, first shut off the steam supply leading to the jacket. By this time a considerable quantity of alcohol fume and water vapor had filled the room. He next pulled the electric knife switch and the explosion immediately occurred. Fire doors on the nearby elevator shaft and at the other side of the room about 50 ft. away were blown down and the windows were shattered. None of the woodwork was scorched and the rack of time cards a few feet from the switch had only one or two cards browned at the edges. Six operators were injured, three of them seriously burned. William Copeland, who pulled the switch, and Elmer Groskopf, standing near by at the time, both died in the hospital two days later.

It is apparent from the testimony of witnesses that the fumes were ignited by an electric spark incidental to the shutting down of the motor. This spark may have been furnished by the brushes on the motor commutator, by an arc on the knife switch or by the starter contact arcing as it passed over the segments. While the "Square D" knife switch is totally inclosed by a sheet iron case, the cover was not gasketed to prevent the permeation of explosive fumes.

Total gas-tight inclosure of all electrical apparatus in chemical plants handling flammable or explosive gases would do much to obviate such accidents, for it is not always possible to control fumes. The new process plant being erected by the Abbott Laboratories at North Chicago will have fireproof compartments and the electrical apparatus will be in separate chambers from the process machinery.

### Ceramic Society to Visit England Next Year

At a recent meeting of the Glass Division of the American Ceramic Society a letter was received from Dr. Turner, head of the Society of Glass Technology of England, inviting the entire membership of the American Ceramic Society to attend the joint conference in England in 1922.

The American Ceramic Society is now soliciting its membership to ascertain how many members contemplate making this trip. They plan to leave the United States about Aug. 15 and remain in England about one month, visiting glass- and clay-working plants of the British Empire.

The itinerary covers a three weeks trip, including visits not only to glass works in different cities in England and Scotland but the china works and other industries at Derby and Stokes and the fireclay and material works at Stourbridge.

### Brussels Meeting, International Union of Pure and Applied Chemistry

The 1921 meeting of the International Union of Pure and Applied Chemistry was held in Brussels from June 25 to 30, under the presidency of Prof. Charles Moureaux, member of the Institut de France. At a preliminary meeting, the Council, composed of representatives of countries already admitted (see *CHEM. & MET.*, vol. 23, p. 210), unanimously approved the admission to the Union of Argentina, Japan, Monaco, Norway, Portugal, Rumania, Switzerland, Uruguay and Yugoslavia. Eighty-two delegates from eighteen countries were present. Dr. F. C. Cottrell, Prof. C. Mackall and Prof. J. B. Conant represented the United States, while Great Britain sent Sir William Pope, Dr. S. Miall and Prof. T. M. Lowry. France had 26 delegates, Belgium 15, Italy 12, Netherlands 4 and Switzerland 4.

Further Council meetings and the general assembly were devoted largely to a discussion of the reports of committees appointed last year at the meeting in Rome.

#### COMMITTEE ON ATOMIC WEIGHTS

The existing International Committee on Atomic Weights is to be reorganized as the International Committee on Chemical Elements. It will consist of twelve members, divided into three sub-committees to deal with atomic weights, the compilation of a table of isotopes, and the constants of radioactive elements.

#### NOMENCLATURE

The report of the committee on nomenclature, adopted unanimously, recommends: (a) The formation of three international committees on nomenclature to deal with organic chemistry, inorganic chemistry and biological chemistry respectively. (b) The formation of three working sub-committees, of six members each, elected by the international committees, each member being intrusted with the task of forming, with the aid of his national federation, a national committee to discuss questions of nomenclature; the proposals put forward by a national committee to be embodied in a report for circulation among chemists of other nationalities.

#### CHEMICAL ABSTRACTS

The following recommendations relating to the unification of abstracts, put forward by the National Council of the Netherlands, were accepted: (1) That the Bureau of the International Union take the initiative in bringing together representatives of chemical journals that publish abstracts with a view to discussing the eventual formation of a central publication and its probable cost. (2) That the possibility of conducting an international chemical card index be investigated together with the approximate costs of establishing and maintaining it.

#### INTERNATIONAL INSTITUTE OF CHEMICAL STANDARDS

In order to avoid confusion, M. Timmermans recommended that the three sections of the International Institute of Chemical Standards be named as follows: Bureau of Physicochemical standards (headquarters at Brussels); Research Chemicals (headquarters in England); Department of Publications Concerning Industrial and Technical Products (headquarters in Paris).

#### CERAMIC PRODUCTS AND FUELS

The establishment of national and international laboratories for the study of ceramic products and fuels was approved. Laboratories for the investigation of refractories will be attached to the fuel laboratories as special sections.

#### INTERNATIONAL PATENTS

The committee on international patents was re-appointed for another year. A resolution was passed by the assembly to the effect that the institution of international patents is highly desirable and that the Union should take the initiative by calling a conference to consider the question.

Reports on bibliographical contractions, the mechanical standards, tables of constants, analyses of foodstuffs, and international hygiene were also considered. It was resolved that the next meeting of the Union be held in France.

### Conditions in the Brass Industry

A recent survey of conditions in the brass industry, taking Waterbury, Conn., one of the largest centers of this character in the country, as a barometer, shows that the trend is upward, with greater plant activity and larger number of operatives engaged. The reports of the different important companies in this district, show the following:

The American Brass Co. is now giving employment to as many men as in 1914 and 1915, working on a basis of forty hours a week, instead of regular time of fifty-five hours, as obtained in the two previous years noted.

Scovill Mfg. Co., manufacturing both brass and copper products, is employing the same working force as in 1914, with curtailed running time making about 60 per cent of normal pre-war capacity.

The Chase Metal Works and the Chase Rolling Mills are giving employment to about one-third of the number of operatives as compared with a year ago.

The Waterbury Mfg. Co. is operating at about 50 per cent of normal at the present time.

The American Ring Co. is employing about 75 per cent of its normal working force, with curtailed time approximating thirty-two hours a week. One department at the mills is operating on a 45-hour weekly schedule.

The Randolph-Clowes Co. is giving employment to about two-thirds of its regular force under a 32-hour week, instead of normal 55-hour running time.

The Mattatuck Mfg. Co. is using 80 per cent of its normal number of employees, with running time from 60 to 70 per cent of the regular schedule.

The Waterbury Buckle Co. is operating on a full-time basis.

The Novelty Mfg. Co. is employing two-thirds of its regular working force on a 45-hour weekly running time basis.

Blake & Johnson, brass and iron hardware, are operating with about 75 per cent of the normal working force, four days a week.

### Status of Japanese Chemical Industry

It is necessary to establish a large government laboratory where the necessary experts can be trained, says Dr. Takamatsu, Director of the Tokyo Industrial Laboratory, in an official bulletin, if Japan is to hold her own in developing her chemical industry.

Before the war, he writes, Japan had to import most of her dyes and chemicals, especially from Germany. During the war the law for the encouragement of the dyeing and chemical industries was passed and in 1916 the Japan Dyestuff Manufacturing Co. was established. Though this company has done its best, lack of funds and of expert workers has hampered its activities and even last year the imports of dyes were very large. They are likely to be much larger this year, judging from prevailing conditions.

During the war numbers of dye works were started in various parts of Japan, but nearly all of them have disappeared since the depression set in. Those that still hold on are working on a very small scale, have no permanent plans of business, but are looking only to immediate profits. The chemical industry, which is of so much importance to Japan, cannot be developed on such narrow lines, and the assistance of the government in the direction already indicated is urgently necessary.

The Japan Dyestuff Co., it is reported, is contemplating the engagement of dye experts from Germany. Such a plan may also be adopted by other chemical works in the country, which feel the necessity of a thoroughgoing reform of the industry.

### Joint Dye Committee Named

In an effort to work out some compromise in the dye embargo controversy, a joint committee representing the Finance Committee of the Senate and the Ways and Means Committee of the House has been designated to study the existing situation. The Finance Committee will await the recommendations of the joint committee before deciding whether or not it will replace the dye embargo in the tariff bill. Included in the joint committee's membership are members of the committees representing each side of the controversy.

### Bureau of Soils to Continue Phosphoric Acid Experiments

Investigations by the Bureau of Soils in the matter of extracting phosphoric acid from phosphate rock by the application of heat are to be continued. The bureau has issued the following official notice in that connection:

With the installation of a new high-temperature oil-burning furnace at the experimental farm at Arlington, Va., the Bureau of Soils, United States Department of Agriculture, will continue investigations into the extraction of phosphoric acid for fertilizer from phosphate rock by the application of heat.

Experimental runs with an old furnace several months ago apparently demonstrated the practicability of the new method developed by department scientists of separating the phosphoric acid. The present commercial method is by the application of sulphuric acid to ground phosphate rock. It is not practicable for low-grade rocks and makes necessary the shipment of a large proportion of inert material with the phosphate. Early experiments in separation by heat were made with electric furnaces, but the expense seemed a serious obstacle to the introduction of the new method. It was found, however, that the petroleum-burning furnace could be made to do the work at much less expense. Experiments will be continued to establish methods which will permit the use of much phosphate rock which now goes to waste, and also to a material reduction in freight rates on commercial fertilizers.

### Transportation of Poisonous Articles

The Interstate Commerce Commission has acted favorably upon the petition of the American Smelting & Refining Co. and has amended one of the paragraphs of the regulations covering the transportation of dangerous articles, as follows:

"Arsenic, paris green, arsenate of lead, calcium arsenate and all other strongly poisonous articles must not be offered nor accepted for shipment in bulk, but must be packed in strong and tight containers which will prevent sifting or escape of contents in transit, provided that sintered arsenical flue dust may also be shipped between plants in steel gondola cars equipped with suitable covers."

### Complete Utilization of Southern Pine Waste

An invitation has been extended by Joseph H. Wallace & Co. to the chemists who attend the fall meeting of the American Chemical Society and others who may be interested, to visit the company's research laboratory at Stamford, Conn., where much work has been done on the complete utilization of Southern pine waste. The laboratory will be open to visitors on Sunday, Sept. 11. Stamford is one hour from New York on the New Haven road and the laboratory is ideally situated on Webb's Hill, about five miles north of the station.

### New Brick to Be Tested

A new cinder cement brick, manufactured under a process invented by Sigurd Bo, at the plant of the Farmingdale Cement Brick Co., Farmingdale, L. I., will be subjected to a series of tests at Columbia University, commencing Aug. 29. It is claimed that the new brick is stronger, lighter and cheaper than any other kind now in use. It has been tested by the New York Bureau of Buildings, and its approval by the department depends upon the results of the tests at the University.

### Extension of Temporary Dye Control

With the increasing possibilities that the permanent tariff bill will not become a law much before Jan. 1, the Senate Committee on Finance amended the bill which passed the House in the matter of extending the temporary control over dyes and chemicals so as to continue the present procedure until Jan. 1, 1922.

### Officials of German Potash Syndicate to Visit U. S.

A recent cable from Berlin states that several delegates of the Kalisyndikat will sail from Germany for the United States in September. They will make a careful survey of the potash market in America.

## Personal

GERALD C. BAKER, who is on the sanitary chemistry staff of the State University of Iowa, is working during the summer on the problem of water softening with the Barromite Co. of America, in Chicago.

NEIL C. BOWMAN, president of the Pocono Rubber Cloth Co., Trenton, N. J., gave an interesting address at a luncheon and meeting of the local Rotary Club, Aug. 10, on the subject of "Rubber Cloth." The talk covered features of manufacture, and dealt particularly with rubber cloth for the automobile industry.

Dr. ALFRED S. BURDICK has been elected by the board of directors of the Abbott Laboratories, Chicago, as president, to fill the vacancy caused by the recent death of Dr. W. C. Abbott.

E. DANA DURAND has been appointed chief of the newly created eastern European division of the Bureau of Foreign and Domestic Commerce. Mr. Durand was director of the Bureau of the Census from 1909 to 1913, and from 1903 to 1909 was connected with the Bureau of Corporations of the Department of Commerce and Labor, first as economic expert and later as deputy commissioner.

OTTO EISENSCHIML sailed on July 26 for a two months' visit to Austria, where he will attend to personal matters.

Dr. HERBERT E. FOOTE, of Dover, N. J., experimental chemist at the Picatinny Arsenal of the Government, near Dover, was hurt seriously while engaged at his work Aug. 12, covering certain experiments with the nitration of benzene. He was removed to the Dover General Hospital, and the fear is expressed that he will suffer the loss of one of his eyes. The explosion in the laboratory slightly injured Dr. Foote's assistant, Frank McPeck, but with no serious consequences.

A. P. GLOECKLER has resigned as chief chemist of the Tropical Paint & Oil Co., Cleveland, Ohio, and has accepted the position of superintendent of the paint department of the Acorn Refining Co., Cleveland, Ohio.

O. C. JOHNSON is leaving the employ of Swift & Co. to become instructor in chemistry at the Ewing Christian College in India. He sailed from New York on July 30, and will spend at least three years in India.

Dr. IRVING LANGMUIR, assistant director of the research laboratory of the General Electric Co., sailed for Europe Aug. 13 to attend the annual meeting of the British Association for the Advancement of Science to be held in Edinburgh, Scotland, Sept. 7 to 14. He will also attend a meeting of the Faraday Society in London on Sept. 28 and will be awarded the honorary degree of Doctor of Laws by the University of Edinburgh on Sept. 13. Dr. Langmuir will open the discussion on Molecular Structure at the British Association meeting. He will read a paper before the Faraday Society on "Chemical Reactions on Surfaces," and open discussion on that subject. During his stay he will visit a number of European countries on business. He is expected to be absent from the United States between two and three months.

Dr. R. B. MOORE of the U. S. Bureau of Mines is visiting the Western stations of the bureau.

WILLIAM N. PORTER, of the Chemical Warfare Service, has been promoted to the rank of major.

J. LEONARD REPLOGLE, president of the Vanadium Corporation of America and chairman of the Replogle Steel Co., recently returned from a trip to Europe, where he has been studying business conditions.

EARLE E. RICHARDSON, who has been instructing in analytical chemistry and physics for the past four years at the Massachusetts Institute of Technology, has been appointed to the position of research physicist under L. A. Jones at the research laboratories of Eastman Kodak Co., Kodak Park, Rochester, N. Y.

### Lithopone Sales in 1920

The quantity of lithopone marketed during 1920 showed an increase of 14 per cent over the figure for the preceding year, according to the compilation of reports from the manufacturers which has recently been completed by the Geological Survey. Quantity, value and average selling price of lithopone marketed during 1919 and 1920 are shown in the following table. It will be noted that the figures for 1919 differ from those previously published by the Survey, but the explanation is that the earlier statistics were for the quantity of lithopone manufactured and not that which was marketed:

LITHOPONE MARKETING IN 1919-1920

	Quantity, Short Tons	Value	Average Selling Price
1919.....	78,365	\$10,218,850	\$130.40
1920.....	89,373	12,484,925	139.69
Increase.....	11,008	2,266,075	9.29
Percentage.....	14.0	22.2	7.1

## Current Market Reports

### Chemical and Allied Industrial Chemical Markets

NEW YORK, Aug. 22, 1921.

Some improvement in the demand has been noted in the heavy chemical field, although business is still limited to comparatively small lots. Prices all around are firmer, with a less pronounced tendency to shade except in instances where unusually heavy orders are in prospect. Advices from Germany that prices are somewhat firmer, especially in the alum group, have probably caused some stiffening in the New York market. Throughout the trade the feeling is decidedly better and all leading factors are looking forward to greatly improved business in the fall or early winter.

#### CHEMICALS

Buyers of *acetic acid* are not showing any inclination to come into the market and prices remain unchanged with makers' quotations ruling. The price basis is \$2.50@2.75 per 100 lb. for the 28 per cent and 10@10½c. per lb. for the glacial, although occasional small lots may be located in resale hands at lower figures. Buyers of *muratic acid* are showing very little interest, and makers are unable to reduce prices to any further levels. Stocks are not excessive and producers are holding them down as low as possible. Quotations for the 20 deg. range from \$1.25@1.75 per 100 lb. in carload quantities. In spite of the recent sharp declines in nitrate of soda prices, *nitric acid* held steady at recently quoted figures. The demand has been of only a limited nature. Prices are quoted on a basis of 6½@7c. per lb. in carboys for the 40 deg. test in carlot quantities. Prices on *ammonia alum* are based on 3½@4c. per lb. for the lump, with imported and domestic goods competitive. *Potash alum* is offered by importers on a basis of 3½c. per lb. for lump, against a domestic price of 5½c. Cable advices from Germany state that an advance of 50 per cent has been made on alum prices. The announcement has not affected any spot prices, partly on account of the recent decline in the exchange. Quotations on *ammonium carbonate* are given at 7@9c. per lb. according to seller, with lower prices named by importers. It is stated that the lower figure may be shaded on business of a large nature. Importers of *barium chloride* offer prime white crystals at \$48 per ton on the spot and \$46 per ton for arrival. Prices on *barium peroxide* around 24c. per lb. are named for the 86@90 per cent by makers. Offers as low as 17c. per lb. are heard in the spot market, but this material is off grade and it is doubtful if better than 20c. per lb. could be done for good grades.

Small lots of spot *bichromate of soda* are moving at 8c. per lb. and the market appears quite steady on this basis. It is admitted that a few odd lots might be purchased at a slight concession, but dealers are inclined to hold steady at former levels and in some directions higher prices are

named. Transactions are chiefly of a jobbing character, involving only small tonnages. Solid *caustic soda* is higher than noted a week ago, and \$3.90 per 100 lb. was the general quotation for standard brand goods ex-store. Moderate trading was reported at this figure and the tone of the market looked much steadier. Producers are holding contract prices at 3½c. per lb. f.o.b. works, basis 60 per cent, in carload quantities. Manufacturers of *hyposulphite of soda* are accepting business at slightly lower figures, and sales are reported on a basis of \$3.40 per 100 lb. in car lots and 3½c. per lb. in less than carload quantities. The absence of important business in *nitrite of soda* has left the market in a dormant condition. The general quotation is 7@7½c. per lb. according to seller and quantity. A slight reduction might be granted on a firm order for a round lot. Spot sales of *prussiate of soda* are reported at 11½@12c. per lb. and the market was quoted firm at the inside figure. In some quarters it was stated that inquiries were a little freer, although it was admitted that the call was chiefly for small lots. Light *soda ash* on spot is holding quite steady with sales reported at \$2.15@2.20 per 100 lb. in single bags. Barrels are selling at \$2.40@2.50 per 100 lb. ex-store. The inquiry for small quantities in barrels is reported fairly active. Producers continue to name \$1.60 for single bags and \$1.95 for barrels, basis 48 per cent, f.o.b. works. Special prices are being named on contracts to the consuming trade, the price depending upon the quantity involved. Imported ash is offered at \$1.60 per 100 lb., prompt shipment from abroad. Consumers of *bleaching powder* are showing an interest, and sales f.o.b. works are reported from 2@2½c. per lb. in large drums. A few small drum sales occasionally go through at 2½@2¾c. per lb. f.o.b. works. Spot material is quite scarce, with prices about ¾c. above those named at the works for prime fresh material. Dealers of *formaldehyde* are quoting spot material in barrels at 13c. per lb. Some of the larger sellers have accepted less than this figure and state that they have placed business down to 12c. per lb. The low price, however, is confined to large lot quantities. Spot *oxalic acid* is quoted at 16c. per lb. and upward, depending upon the seller and quantity. It is stated that imported material is becoming scarce and that most of the business is on domestic stock. The extreme range of prices is 16@18c. per lb. Prices on white *sal ammoniac* vary considerably and the market at present is governed by the views of individual sellers. The range is from 6@7½c. per lb. The gray material is moving at 7@7½c. per lb., according to quantity, producers naming the inside price f.o.b. works. Importers of fused *sodium sulphide*, 60 per cent, are offering goods at 4½c. per lb., against a domestic price of 5@6c. per lb. Importers of *chlorate of potash* are offering lower at 7½@8c. per lb. Domestic prices are still held at 12@13c. per lb., although subject to shading. Very little interest has been noted from consumers of *caustic potash*, and prices are very soft, although quoted values remain unchanged. Quotations of 4½@4¾c. per lb. are heard from importers, but it is probable that shading of these figures could be done for firm business of a large nature. Domestic makers are still unable to compete.

#### COAL-TAR PRODUCTS

During the past week buying has been light and consumers show little disposition to change their hand-to-mouth methods. The decision of the tariff question is expected to improve feeling, although there is little reason to believe at present that any pronounced revival can come before some decision is reached. Interest, in the meantime, is centered around Washington and the ultimate fate of the licensing feature is anxiously awaited. There are some in the trade who are of the opinion that even the decision of this question will have little effect until general business is better. This is not the general belief, however, in chemical circles. In the absence of any market demand, prices are only secondary and it seems probable that any figures quoted can be materially shaded for firm business. Occasional orders are coming in, but the general tone is dull. Benzene still continues scarce and high in second hands where supplies are only to be had. Beta naphthol continues weak, with makers showing signs of further

weakness. *Paranitraniline* in resale hands is scarce, and makers are firm in their ideas. Producers of *benzene* are firm at 27@33c. per gal. Supplies are limited and export business is being turned down. Resale goods are hard to get, with some odd lots selling at 34@36c. per gal. Sales of *phenol* at prices ranging from 7@9c. per lb. have been made, but it is believed that the quality of these low-priced goods is not up to standard. Offers of prime goods at 9½c. per lb. have been heard. Better prices could undoubtedly be had on firm business, as there is a great amount of surplus stocks in practically every direction. Producers ask 15@16c. per lb. Prices on *H acid* are named at \$1.15@1.25 per lb., according to maker. A few small orders have come in, but few consumers are interested. The market on *aniline oil* continues dull, with makers willing to compete for business near the 20c. level. Resale lots are said to be available in moderate quantities as low as 18c. per lb. Makers are pretty well in line at 20c. per lb., although higher figures are quoted in some quarters. Some improvement has been noted in the demand from the rubber trade. Offers of low-priced *benzidine base* are very scarce and it seems probable that no first quality material can be had below \$1@1.10 per lb., quoted according to maker. Consumers are not showing much interest and it seems that even lower prices would not induce them to buy at present. Makers of *dimethylaniline* are quoting down to 45c. per lb., while others hold for prices up to 60@64c. per lb. The resale market is practically bare of supplies. The demand, in general, is rather slow. Makers' prices on *diphenylamine* rule at 65@70c. per lb. according to quantity. Business in this commodity is somewhat slow. Manufacturers of *paranitraniline* are holding their prices at 79@82c. per lb., merely to feel out prospective buyers. There is unquestionably a tendency to shade these figures rather than lose any passing business.

#### VEGETABLE OILS

Some importers of *chinawood oil* reported the spot situation as slightly easier, but with actual offerings scanty, the market was merely nominal where prices were concerned. Recent business in spot oil went through at 17c. per lb., but it was said that scattered lots could have been picked up at concessions. One operator thought that 12c. could be done. Early September arrivals were offered at 12½c. per lb., with buyers backward. September-October shipment from the Orient closed at 10½@11c. per lb., c.i.f. New York. The market for *coconut oil* was less active, but prices for Manila oil on the Coast ruled firm. One sale was recently noted of 500 tons, sold on the bulk basis of 7½c. per lb., c.i.f. San Francisco. Scattered lots of tank cars were reported at 8½c. per lb., f.o.b. Coast, September-October shipment. Some holders on the Coast were asking 8½c. per lb. for prompt and nearby oil. Receipts of *olive oil* from Italy and Spain continue on a liberal scale and the market has shown no signs of improvement. Prices for edible oil were unsettled, ranging from \$1.80@2.20 per gal. Denatured oil closed nominally at \$1.10 per gal. Both soapmakers and tin plate mills have been showing more buying interest in *palm oils* and importers report that a good volume of business has been placed during the past week. *Lagos oil* is offered sparingly on spot in small lots as high as 7½c. per lb. On shipment goods, 7c. was asked. *Niger oil* closed at 5½c. per lb. to arrive, with sales noted around this level. There was a quiet but steady market for domestic crude *peanut oil*. At the close holders were asking 7½c. per lb., buyers' tanks, f.o.b. mills for the prime quality.

#### The St. Louis Market

ST. LOUIS, Aug. 19, 1921.

There is evidence of a broadening of business in many localities, with more frequent spot orders, increased quantities and wider range of material which has stimulated the market quite a bit. Furthermore it is apparent that more confidence and optimism exist for the future. It is the opinion of most of the factors that the disturbing element which existed has been practically eliminated, which they hold as indicative of sounder and more stable business for the coming season. The general trend of the

market continues to be downward and many commodities undoubtedly have reached a minimum.

#### ALKALIS

*Sal soda* is very dull. *Soda ash* remains at manufacturers' schedule with slight increase in demand and movement. *Sodium bicarbonate* demand is quiet with prices from \$2.60 to \$2.75 per 100 lb. in less than carlots. *Caustic soda* continues to enjoy good demand. Contract buyers continue to consume their allotments and the price has stiffened to \$4 per 100 lb., basis 73-75 per cent solid, f.o.b. point of production.

#### CHEMICALS, DRUGS AND PHARMACEUTICALS

*Acetanilid* and *acetphenetidin* are not moving, due to the fact that these are unseasonable products. *Bismuth subnitrate* continues to move in large volume and manufacturers are in position to keep abreast with the demand. *Caffeine alkaloid* shows no exceptional activity and makers recently reduced their price. *Carbon bisulphide* is still among the active articles, with a demand for substantial quantities. Business in *chloral hydrate* is not very brisk and shading in prices has been heard of but without confirmation. *Cream of tartar* commands a fair demand. Manufacturers report a good volume of business on *cumarin*. *Glycerine* has declined no further and was quoted for spot and contract at 14½c. per lb. Little effort was being made by the producers to book contracts, as they consider the present price too low. *Soda glycerophosphate* has recently been reduced. *Hydrogen peroxide* continues to move steadily, but is still below past sales. *Iodides*, particularly *potash*, have shown an encouraging increase during the past two weeks. Now is the time to prepare for the winter season and wholesalers and consumers should not overlook their stocks on *salicylates*, *guaiacols*, *creosote* and *acetylsalicylic*, as these articles will certainly be in demand with the first cold period. *Sulphur* continues in routine demand with advance in price of \$2.10 per 100 lb. for commercial in bags. *Zinc oxides* remain the same in price and demand is much below routine. *Zinc sulphate* is being offered at 3½c. per lb., f.o.b. St. Louis, with few inquiries.

#### ACIDS

Producers report a very appreciable increase in inquiry and demand for heavy acids, especially *sulphuric acid*, which is now moving in good volumes, and the manufacturers are very optimistic regarding the future. In some localities the demand for *citric acid* has improved, but the general demand is still below normal. *Acid pyrogalllic* continues to increase. *Tartaric acid* is favorable with a routine business.

#### VEGETABLE OILS

*Linseed oil* declined to 75c. basis raw in barrels from warehouse and has recently advanced again and holds very firm at 78c., with further advances expected. *Castor oil* continues in good demand, with price firm at 11½c. per lb. for No. 1 U.S.P. in returnable drums. *Turpentine* has advanced from its position of two weeks ago, and today is quoted at 60½c. in 5-bbl. lots. The demand is also better.

#### PAINT MATERIALS

*Lithopone* remains same in price with slight increase in demand. Many inquiries are being received on *dry earth colors* for the purpose of revising costs for the expected fall demand.

#### The Iron and Steel Market

PITTSBURGH, Aug. 19, 1921.

It requires very close analysis to show any change in the steel market situation in the week under review. There is a slight increase in demand upon the mills, in the aggregate, but the increase is probably smaller than in recent weeks, the trend toward heavier demand having begun about the middle of July. The character of demand is unchanged, orders being widely distributed geographically and by classes of buyers, while orders are, as formerly, chiefly for single carloads.

Steel prices likewise show little if any change. The regular or openly quoted prices are unchanged, there having indeed been no material change since the beginning of the

month. As for some time past, concessions can be obtained from these prices in the case of particularly desirable orders, whether in point of tonnage or of specifications. It is a question whether the concessions average more or less than a fortnight ago, but a change either way would not prove the market to be either better or worse. A larger concession might be quoted because a larger order was offered, or concessions might be less because less desirable business is going.

Much of the comment on the steel market is along the line that there is no forward buying, hence the market is still in very poor shape. This scarcely seems like a practical view. Steel mill operations dropped to below 20 per cent of capacity at the middle of July, and it ought not to be difficult to arrive at the conclusion that the mills needed prompt buying first. It is true that forward buying is essential in order that prices may be advanced, but the first objective of the steel mills necessarily is more business.

Steel mill operations have probably attained an average close to 25 per cent of capacity, against an average of about 21 per cent in July and a low point of less than 20 per cent at the middle of that month. This is on the basis of ingot production. Shipments of finished steel products have increased somewhat more, as there has been drawing upon the small remaining stocks of finished steel at mills, as well as a little rolling of semi-finished steel that had accumulated.

On the whole, the proportion of demand that comes from jobbers as compared with the demand from manufacturing consumers seems to be above the normal. This would tend to confirm the general analysis of the situation given in previous reports, that demand has suffered on account of the existence of stocks of steel and of manufactured goods, which have to be liquidated. The jobbing demand, which is for material to be distributed at once to small users, would naturally not be affected so much by stocks. It is noted that jobbers in the South, catering to agricultural trade, are particularly active.

There is heavy demand for galvanized sheets for making and repairing box car roofs, against the requirements of the fall movement of agricultural products. The automobile trade is somewhat more active than a month or two ago and while production of automobiles is below the best rate in the late spring the demand for steel is greater because at that time stocks of steel were being used. There is only a little demand from the oil fields, nothing at all comparable to a normal demand.

#### PRICES

As to openly quoted prices for steel products, against inquiries for carloads to 100 tons, prices of the leading products are unchanged since about the first of the month, except that blue annealed sheets are now commonly quoted at 2.25c. for orders at all attractive, against 2.40c. quoted a week ago. Concessions from regular prices, when named on attractive inquiries, are generally \$1 or \$2 a ton, occasionally reaching \$3 a ton, and this applies to most commodities except wire products and standard steel pipe, concessions on which are relatively small.

Pig iron has begun to show signs of an advancing tendency, this being a natural reaction, since in many cases prices done in the open market had passed below the cost of replacement, and were due to a desire to liquidate stocks. While buying has appeared to be very light right along, it appears that there really has been considerable liquidation. Some Chicago furnaces had sold foundry iron at \$18 furnace, while quotations are now advanced to \$20. Whether there will be any buying at the new price remains to be seen. In the valley market there is the interesting development that many if not all the producers have marked up basic iron from \$18 to \$20. Even in the latter part of last week there were sales on the \$18 basis. The valley market remains quotable at \$20 for bessemer, \$18 for basic and \$19.50 for foundry, f.o.b. furnace, on the basis that the market is quotable at last sales made.

Connellsville furnace coke remains at \$3 as the common asking price, with concessions frequently possible of about 10c. on standard coke. Standard foundry coke remains at \$4@4.50.

#### General Chemicals

##### CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots	Less Carlots
Acetic anhydride.....lb.		\$0.40 - \$0.45
Acetone.....lb.	\$0.12 - \$0.121	.13 - .131
Acid, acetic, 28 per cent.....100 lbs.	2.50 - 2.75	3.00 - 3.25
Acetic, 56 per cent.....100 lbs.	5.00 - 5.25	5.50 - 6.00
Acetic, glacial, 99½ per cent, carboys, 100 lbs.	10.00 - 10.25	10.50 - 10.75
Boric, crystals.....lb.	.12 - .13	.13 - .14
Boric, powder.....lb.	.13 - .131	.14 - .141
Citric.....lb.		.44 - .45
Hydrochloric.....100 lb.	1.25 - 1.50	1.60 - 1.75
Hydrofluoric, 52 per cent.....lb.	.11 - .111	.12 - .121
Lactic, 44 per cent tech.....lb.	.10 - .11	.11 - .12
Lactic, 22 per cent tech.....lb.	.04 - .051	.06 - .07
Molybdic, C. P.....lb.	4.00 - 4.50	4.50 - 5.00
Muriatic, 20 deg. (see hydrochloric).....lb.		.07 - .071
Nitric, 40 deg.....lb.	.06 - .061	.07 - .071
Nitric, 42 deg.....lb.	.07 - .071	.07 - .071
Oxalic, crystals.....lb.	.16 - .161	.17 - .18
Phosphoric, 50 per cent solution.....lb.	.13 - .131	.14 - .18
Picric.....lb.	.20 - .25	.27 - .35
Pyrogallol, resublimed.....lb.		1.75 - 1.90
Sulphuric, 60 deg., tank cars.....ton		11.00 - 13.00
Sulphuric, 60 deg., drums.....ton		13.00 - 15.00
Sulphuric, 66 deg., tank cars.....ton	18.00 - 20.00	
Sulphuric, 66 deg., drums.....ton	21.00 - 22.00	22.50 - 23.00
Sulphuric, 66 deg., carboys.....ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars.....ton	21.00 - 22.00	
Sulphuric, fuming, 20 per cent (oleum) drums.....ton	23.00 - 23.50	24.00 - 24.50
Sulphuric, fuming, 20 per cent (oleum) carboys.....ton	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.....lb.		.75 - .85
Tannic (tech.).....lb.	.45 - .48	.50 - .55
Tartaric, crystals.....lb.		.26 - .28
Tungstic, per lb. of WO.....lb.		1.30 - 1.40
Alcohol, Ethyl.....gal.		4.65 - 4.75
Alcohol, Methyl (see methanol).....gal.		
Alcohol, denatured, 188 proof.....gal.		.35 - .36
Alcohol, denatured, 190 proof.....gal.		.37 - .38
Alum, ammonia lump.....lb.	.03 - .031	.04 - .041
Alum, potash lump.....lb.	.03 - .04	.04 - .041
Alum, chrome lump.....lb.	.10 - .11	.11 - .12
Aluminum sulphate, commercial.....lb.	.02 - .021	.02 - .021
Aluminum sulphate, iron free.....lb.	.03 - .031	.03 - .04
Aqua ammonia, 26 deg., drums (750 lb.).....lb.	.07 - .071	.08 - .081
Ammonia, anhydrous, cyl. (100-150 lb.).....lb.	.30 - .32	.33 - .35
Ammonium carbonate, powder.....lb.	.07 - .071	.08 - .09
Ammonium chloride, granular (white sal ammoniac).....lb.	.06 - .061	.06 - .071
Ammonium chloride, granular (gray sal ammoniac).....lb.	.07 - .071	.07 - .08
Ammonium nitrate.....lb.	.07 - .071	.07 - .081
Ammonium sulphate.....100 lb.	2.20 - 2.25	2.30 - 2.40
Amylacetate.....gal.		3.25 - 3.50
Amylacetate tech.....gal.		2.50 - 3.00
Arsenic oxide, (white arsenic) powdered lb.....lb.	.06 - .061	.07 - .071
Arsenic, sulphide, powdered (red arsenic).....lb.	.11 - .111	.12 - .13
Barium chloride.....ton	48.00 - 50.00	51.00 - 53.00
Barium dioxide (peroxide).....lb.	.20 - .21	.22 - .23
Barium nitrate.....lb.	.08 - .081	.08 - .091
Barium sulphate (precip.) (blanc fixe).....lb.	.04 - .041	.04 - .051
Bleaching powder (see calc. hypochlorite).....lb.		
Blue vitriol (see copper sulphate).....lb.		
Borax (see sodium borate).....lb.		
Brimstone (see sulphur, roll).....lb.		
Bromine.....lb.	.27 - .28	.28 - .30
Calcium acetate.....100 lbs.	2.00 - 2.05	
Calcium carbide.....lb.	.04 - .041	.05 - .051
Calcium chloride, fused, lump.....ton	23.50 - 24.00	24.50 - 25.50
Calcium chloride, granulated.....lb.	.01 - .02	.02 - .021
Calcium hypochlorite (bleach powder) 100 lb.....lb.	2.65 - 2.75	3.00 - 3.50
Calcium peroxide.....lb.		1.40 - 1.50
Calcium phosphate, tribasic.....lb.		.15 - .16
Camphor.....lb.		.68 - .70
Carbon bisulphide.....lb.	.06 - .061	.06 - .071
Carbon tetrachloride, drums.....lb.	.10 - .101	.11 - .12
Carbonyl chloride (phosgene).....lb.		.60 - .75
Caustic potash (see potassium hydroxide).....lb.		
Caustic soda (see sodium hydroxide).....lb.		
Chlorine, gas, liquid-cylinders (100 lb.).....lb.	.08 - .09	.09 - .10
Chloroform.....lb.		.38 - .43
Cobalt oxide.....lb.		2.35 - 2.40
Coppers (see iron sulphate).....lb.		
Copper carbonate, green precipitate.....lb.	.19 - .191	.20 - .21
Copper cyanide.....lb.		.50 - .62
Copper sulphate, crystals.....lb.	.05 - .051	.06 - .061
Cream of tartar (see potassium bitartrate).....lb.		
Epsom salt (see magnesium sulphate).....lb.		
Ethyl Acetate, Com. 85%.....gal.		1.00 - 1.10
Ethyl Acetate (pure (acetic ether 98% to 100%)).....lb.		.40 - .42
Formaldehyde, 40 per cent.....lb.	.12 - .121	.12 - .131
Fusel oil, red.....gal.		3.25 - 3.75
Fusel oil, crude.....gal.		1.50 - 1.75
Glauber's salt (see sodium sulphate).....lb.		
Glycerin, C. P., drums extra.....lb.		.14 - .15
Iodine, resublimed.....lb.		3.50 - 3.60
Iron oxide, red.....lb.		.10 - .20
Iron sulphate (copperas).....ton	19.00 - 20.00	21.00 - 22.00
Lead acetate.....lb.		.10 - .121
Lead arsenate, paste.....lb.	.09 - .091	.10 - .11
Lead nitrate.....lb.	.07 - .071	.15 - .20
Litharge.....lb.		.08 - .081
Lithium carbonate.....lb.		1.30 - 1.40
Magnesium carbonate, technical.....lb.	.09 - .091	.10 - .11
Magnesium sulphate, U. S. P.....100 lb.	2.40 - 2.75	1.15 - 1.65
Magnesium sulphate, technical.....100 lb.		.66 - .68
Methanol, 95%.....gal.		.70 - .72
Methanol, 97%.....gal.		.72 - .73
Nickel salt, double.....lb.		.12 - .121
Nickel salt, single.....lb.		.14 - .141
Phosgene (see carbonyl chloride).....lb.		.42 - .45
Phosphorus, red.....lb.	.40 - .41	.30 - .35
Phosphorus, yellow.....lb.		.12 - .121
Potassium bichromate.....lb.	.11 - .111	

	Carlots	Less Carlots
Potassium bitartrate (cream of tartar)..... lb.	\$ . . . \$ . . .	\$0.28-\$0.29
Potassium bromide, granular..... lb.		.16-.25
Potassium carbonate, U. S. P..... lb.	.35-.40	.45-.50
Potassium carbonate, 80-85%..... lb.	.05-.05	.06-.06
Potassium chlorate, crystals..... lb.	.07-.08	.08-.10
Potassium cyanide..... lb.		.26-.28
Potassium hydroxide (caustic potash)..... lb.	.04-.05	.05-.06
Potassium muriate, 80% K.C.L..... ton	42.50-45.00	
Potassium iodide..... lb.		2.75-3.00
Potassium nitrate..... lb.	.09-.09	.10-.12
Potassium permanganate..... lb.	.25-.26	.26-.27
Potassium prussiate, red..... lb.	.28-.29	.29-.30
Potassium prussiate, yellow..... lb.	.21-.22	.22-.23
Potassium sulphate (powdered)..... per unit		1.25-1.30
Rochelle salts (see sodium potas tartrate).....		
Salammoniac (see ammonium chloride).....		
Sal soda (see sodium carbonate).....		
Salt cake..... ton		22.00-25.00
Silver cyanide..... oz.		1.35-1.38
Silver nitrate..... oz.		.41-.42
Soda ash light..... 100 lb.	2.15-2.20	2.25-2.75
Soda ash, dense..... 100 lb.	2.35-2.40	2.45-2.70
Sodium acetate..... lb.	.04-.04	.04-.05
Sodium bicarbonate..... 100 lb.	2.25-2.40	2.50-2.75
Sodium bichromate..... lb.	.08-.08	.08-.09
Sodium bisulphate (nitre cake)..... ton	5.00-5.25	5.50-6.50
Sodium bisulphate powdered, U.S.P..... lb.	.04-.05	.05-.06
Sodium borate (borax)..... lb.	.05-.06	.06-.06
Sodium carbonate (sal soda)..... 100 lb.	1.90-2.00	2.10-2.40
Sodium chl rate..... lb.	.07-.07	.08-.08
Sodium cyanide..... lb.	.19-.21	.22-.30
Sodium fluoride..... lb.	.11-.11	.12-.13
Sodium hydroxide (caustic soda)..... 100 lb.	3.90-3.95	4.00-4.60
Sodium hyposulphite..... lb.		.03-.03
Sodium nitrite..... 100 lb.	2.10-2.10	2.30-2.30
Sodium nitrate..... lb.	.07-.07	.07-.08
Sodium peroxide, powdered..... lb.	.25-.26	.27-.30
Sodium phosphate, dibasic..... lb.	.04-.04	.05-.05
Sodium potassium tartrate (Rochelle salts)..... lb.		.22-.25
Sodium prussiate, yellow..... lb.	.11-.12	.12-.13
Sodium silicate, solution (40 deg.)..... 100 lb.	1.00-1.15	1.25-1.40
Sodium silicate, solution (60 deg.)..... lb.	.02-.03	.03-.03
Sodium sulphate, crystals (Glauber's salt) 100 lbs.	1.50-1.75	2.00-2.25
Sodium sulphide, fused, 60-62 per cent (conc.)..... lb.	.04-.05	.05-.06
Sodium sulphite, crystals..... lb.	.03-.04	.04-.04
Strontium nitrate, powdered..... lb.	.15-.15	.16-.17
Sulphur chl ride, red..... lb.	.07-.07	.07-.08
Sulphur, crude..... ton	20.00-22.00	
Sulphur dioxide, liquid, cylinders extra..... lb.	.08-.08	.09-.10
Sulphur (sublimed), flour..... 100 lb.		2.25-3.10
Sulphur, roll (brimstone)..... 100 lb.		2.00-2.75
Tin bichloride, 50 per cent..... lb.	.18-.19	
Tin oxide..... lb.		.38-.40
Zinc carbonate, precipitate..... lb.	.15-.16	.16-.17
Zinc chloride, gran..... lb.	.11-.11	.11-.12
Zinc cyanide..... lb.	.42-.44	.45-.47
Zinc dust..... lb.	.11-.11	.11-.12
Zinc oxide, XX..... lb.	.07-.07	.08-.09
Zinc sulphate..... 100 lb.	3.00-3.25	3.30-3.50

## Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude..... lb.	\$1.10-\$1.15
Alpha-naphthol, refined..... lb.	1.25-1.30
Alpha-naphthylamine..... lb.	.35-.40
Aniline oil, drums extra..... lb.	.18-.21
Aniline salts..... lb.	.25-.28
Anthracene, 80% in drums (100 lb.)..... lb.	.75-1.00
Benzaldehyde U.S.P..... lb.	1.00-1.25
Benadine, base..... lb.	1.00-1.10
Benadine sulphate..... lb.	.75-.85
Benzoic acid, U.S.P..... lb.	.60-.65
Benzoate of soda, U.S.P..... lb.	.55-.60
Benzene, pure, water-white, in drums (100 gal.)..... gal.	.27-.32
Benzene, 90%, in drums (100 gal.)..... gal.	.25-.28
Benzyl chloride, 95-97%, refined..... lb.	.25-.27
Benzyl chloride, tech..... lb.	.20-.23
Beta-naphthol benzoate..... lb.	3.50-4.00
Beta-naphthol, sublimed..... lb.	.70-.75
Beta-naphthol, tech..... lb.	.32-.35
Beta-naphthylamine, sublimed..... lb.	1.75-1.80
Cresol, C. S. P., in drums (100 lb.)..... lb.	.16-.18
Ortho-cresol, in drums (100 lb.)..... lb.	.25-.27
Cresylic acid, 97-99%, straw color, in drums..... gal.	.68-.75
Cresylic acid, 75-97%, dark, in drums..... gal.	.65-.70
Cresylic acid, 50%, first quality, drums..... gal.	.45-.50
Dichlorobenzene..... lb.	.06-.09
Diethylaniline..... lb.	1.20-1.25
Dimethylaniline..... lb.	.45-.55
Dinitrobenzene..... lb.	.26-.28
Dinitrochlorobenzene..... lb.	.20-.30
Dinitronaphthalene..... lb.	.30-.40
Dinitrophenol..... lb.	.35-.40
Dinitrotoluene..... lb.	.27-.30
Dip oil, 25% car lots, in drums..... gal.	.40-.45
Diphenylamine..... lb.	.65-.70
H-acid..... lb.	1.15-1.25
Meta-phenylenediamine..... lb.	1.15-1.20
Monochlorobenzene..... lb.	.12-.14
Monothylaniline..... lb.	1.75-1.85
Naphthalene crushed, in bbls..... lb.	.06-.07
Naphthalene, flake..... lb.	.06-.08
Naphthalene, balls..... lb.	.08-.09
Naphthionic acid, crude..... lb.	.70-.75
Nitrobenzene..... lb.	.12-.15
Nitro-naphthalene..... lb.	.30-.35
Nitro-toluene..... lb.	.16-.18
Ortho-amidophenol..... lb.	3.10-3.20
Ortho-dichlor-benzene..... lb.	.15-.20
Ortho-nitro-phenol..... lb.	.80-.85
Ortho-nitro-toluene..... lb.	.15-.20
Ortho-toluidine..... lb.	.20-.25
Para-amidophenol, base..... lb.	1.40-1.45
Para-amidophenol, HCl..... lb.	1.60-1.75

Para-dichlorobenzene..... lb.	.15-.20
Paranitroaniline..... lb.	.75-.80
Para-nitrotoluene..... lb.	.85-.95
Para-phenylenediamine..... lb.	1.70-1.75
Para-toluidine..... lb.	1.25-1.40
Phthalic anhydride..... lb.	.50-.60
Phenol, U. S. P., drums..... lb.	.09-.11
Pyridine..... gal.	2.00-3.50
Resorcinol, technical..... lb.	1.60-1.65
Resorcinol, pure..... lb.	2.25-2.30
Salicylic acid, tech., in bbls..... lb.	.19-.22
Salicylic acid, U. S. P..... lb.	.20-.25
Salol..... lb.	.60-.75
Solvent naphtha, water-white, in drums, 100 gal..... gal.	.25-.28
Solvent naphtha, crude, heavy, in drums, 100 gal..... gal.	.14-.16
Sulphanilic acid, crude..... lb.	.27-.30
Tolidine..... lb.	1.25-1.35
Toluidine, mixed..... lb.	.40-.45
Toluene, in tank cars..... gal.	.25-.28
Toluene, in drums..... gal.	.28-.31
Xylidines, drums, 100 gal..... lb.	.40-.45
Xylene, pure, in drums..... gal.	.40-.45
Xylene, pure, in tank cars..... gal.	.45-.45
Xylene, commercial, in drums, 100 gal..... gal.	.33-.35
Xylene, commercial, in tank cars..... gal.	.30-.30

## Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark..... lb.	\$0.24-\$0.25
Beeswax, refined, light..... lb.	.28-.30
Beeswax, white pure..... lb.	.36-.42
Carnauba, Flora..... lb.	.48-.50
Carnauba, No. 2, North Country..... lb.	.25-.26
Carnauba, No. 3, North Country..... lb.	.15-.16
Japan..... lb.	.18-.20
Montan, crude..... lb.	.06-.06
Paraffine waxes, crude match wax (white) 105-110 m.p..... lb.	.03-.03
Paraffine waxes, crude, scale 124-126 m.p..... lb.	.02-.02
Paraffine waxes, refined, 118-120 m.p..... lb.	.03-.03
Paraffine waxes, refined, 125 m.p..... lb.	.03-.03
Paraffine waxes, refined, 128-130 m.p..... lb.	.04-.04
Paraffine waxes, refined, 133-135 m.p..... lb.	.04-.05
Paraffine waxes, refined, 135-137 m.p..... lb.	.05-.06
Stearic acid, single pressed..... lb.	.09-.09
Stearic acid, double pressed..... lb.	.09-.09
Stearic acid, triple pressed..... lb.	.10-.10

## Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on earload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl..... 280 lb.	\$4.90
Rosin E-F..... 280 lb.	5.00-5.25
Rosin K-N..... 280 lb.	5.35-5.80
Rosin W. G.-W. W..... 280 lb.	6.60-7.35
Wood rosin, bbl..... 280 lb.	6.25-6.25
Spirits of turpentine..... gal.	.62-.62
Wood turpentine, steam dist..... gal.	.60-.60
Wood turpentine, dest. dist..... gal.	.58-.58
Pine tar pitch, bbl..... 200 lb.	7.00-7.00
Tar, kila burned, bbl. (500 lb.)..... bbl.	11.50-11.50
Retort tar, bbl..... 500 lb.	11.50-11.50
Rosin oil, first run..... gal.	.35-.35
Rosin oil, second run..... gal.	.37-.37
Rosin oil, third run..... gal.	.41-.41
Pine oil, steam dist., sp.gr., 0.930-0.940..... gal.	\$1.80
Pine oil, pure, dest. dist..... gal.	1.50-1.50
Pine tar oil, ref., sp.gr. 1.025-1.035..... gal.	.46-.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla..... gal.	.35-.35
Pine tar oil, double ref., sp.gr. 0.965-0.990..... gal.	.75-.75
Pine tar, ref., thin, sp.gr., 1.080-1.960..... gal.	.35-.35
Turpentine, crude, sp. gr., 0.900-0.970..... gal.	1.20-1.20
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990..... gal.	.35-.35
Pinewood creosote, ref..... gal.	.52-.52

## Solvents

73-76 deg., steel bbls. (85 lb.)..... gal.	\$0.37
70-72 deg., steel bbls. (85 lb.)..... gal.	.35-.35
68-70 deg., steel bbls. (85 lb.)..... gal.	.34-.34
V. M. and P. naphtha, steel bbls. (85 lb.)..... gal.	.23-.23

## Crude Rubber

Para-Upriver fine..... lb.	\$0.16-.17
Upriver coarse..... lb.	.09-.09
Upriver cauco ball..... lb.	.11-.12
Plantation—First latex crepe..... lb.	.14-.14
Ribbed smoked sheets..... lb.	.12-.12
Brown crepe, thin, clean..... lb.	.15-.15
Amber crepe No. 1..... lb.	.17-.17

## Oils

## VEGETABLE

The following prices are f.o.b. New York for earload lots.

Castor oil, No. 3, in bbls..... lb.	\$0.09-\$0.09
Castor oil, AA, in bbls..... lb.	.10-.11
China wood oil, in bbls. (f.o.b. Pac. coast)..... lb.	.12-.12
Cocanut oil, Ceylon grade, in bbls..... lb.	.09-.10
Cocanut oil, Cochon grade, in bbls..... lb.	.10-.11
Corn oil, crude, in bbls..... lb.	.08-.08
Cottonseed oil, crude (f. o. b. mill)..... lb.	.06-.07
Cottonseed oil, summer yellow..... lb.	.08-.09
Cottonseed oil, winter yellow..... lb.	.09-.09
Linseed oil, raw, ear lots (domestic)..... gal.	.75-.76
Linseed oil, raw, tank cars (domestic)..... gal.	.69-.70
Linseed oil, in 5-bbl lots (domestic)..... gal.	.77-.78

Olive oil, Denatured.....	gal.	\$1.10	—	\$1.20
Palm, Lagos.....	lb.	.07	—	.07½
Palm, Niger.....	lb.	.05½	—	.06
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.07½	—	.07½
Peanut oil, refined, in bbls.....	lb.	.10	—	.10½
Rapeseed oil, refined, in bbls.....	gal.	.88	—	.90
Rapeseed oil, blown, in bbls.....	gal.	.92	—	.94
Soya bean oil (Manchurian), in bbls. N. Y.....	lb.	.08½	—	—
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.06½	—	—

## FISH

Light pressed menhaden.....	gal.	\$0.40	—	—
Yellow bleached menhaden.....	gal.	.42	—	—
White bleached menhaden.....	gal.	.44	—	—
Blown menhaden.....	gal.	.48	—	—

## Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.....	net ton	\$24.00	—	30.00
Barytes, ground, off color, f.o.b. Kings Creek.....	net ton	22.00	—	26.00
Barytes, crude, 88% @ 94% ba., Kings Creek.....	net ton	10.00	—	12.00
Barytes, floated, f.o.b. St. Louis.....	net ton	26.50	—	28.00
Barytes, crude, first grade, Missouri.....	net ton	7.00	—	—
Blanc fixe, dry.....	lb.	.04½	—	.04½
Blanc fixe, pulp.....	net ton	45.00	—	55.00
Casein.....	lb.	.06½	—	.07½
Chalk, domestic, extra light.....	lb.	.04½	—	.05
Chalk, domestic, light.....	lb.	.04	—	.04½
Chalk, domestic, heavy.....	lb.	.03½	—	.04
Chalk, English, extra light.....	lb.	.04½	—	.05
Chalk, English, light.....	lb.	.04½	—	.05
Chalk, English, dense.....	lb.	.04	—	.04½
China clay (kaolin) crude, f.o.b. mines, Georgia.....	net ton	6.50	—	8.50
China clay (kaolin) washed, f.o.b. Georgia.....	net ton	9.00	—	10.00
China clay (kaolin) powdered, f.o.b. Georgia.....	net ton	13.00	—	20.00
China clay (kaolin) crude f.o.b. Virginia points.....	net ton	8.00	—	12.00
China clay (kaolin) ground, f.o.b. Virginia points.....	net ton	13.00	—	20.00
China clay (kaolin), imported, lump.....	net ton	12.00	—	20.00
China clay (kaolin), imported, powdered.....	net ton	25.00	—	30.00
Feldspar, crude, f.o.b. Maryland and North Carolina points.....	net ton	5.00	—	7.50
Feldspar, crude, f.o.b. Maine.....	net ton	7.50	—	10.00
Feldspar, ground, f.o.b. Maine.....	net ton	21.00	—	23.00
Feldspar, ground, f.o.b. North Carolina.....	net ton	17.00	—	21.00
Feldspar, ground, f.o.b. N. Y. State.....	net ton	17.00	—	21.00
Feldspar, ground, f.o.b. Baltimore.....	net ton	27.00	—	30.00
Fullers earth, f.o.b. Mines.....	net ton	16.00	—	17.00
Fullers earth, granular, f.o.b. Ia.....	net ton	15.00	—	18.00
Fullers earth, powdered, f.o.b. Fla.....	net ton	18.00	—	—
Fullers earth, imported, powdered.....	net ton	24.00	—	27.00
Graphite, Ceylon lump, first quality.....	lb.	.06	—	.07
Graphite, Ceylon chip.....	lb.	.04½	—	.05
Graphite, high grade amorphous crude.....	lb.	.00½	—	.02½
Magnesite, calcined.....	per ton	66.00	—	70.00
Pumice stone, imported, lump.....	lb.	.03	—	.40
Pumice stone, domestic lump.....	lb.	.05	—	.05½
Pumice stone, ground.....	lb.	.06	—	.07
Quartz (acid tower) first to head, f.o.b. Baltimore.....	net ton	—	—	10.00
Quartz (acid tower) 1½ to 2 in., f.o.b. Baltimore.....	net ton	—	—	14.00
Quartz (acid tower) rice, f.o.b. Baltimore.....	net ton	—	—	17.00
Quartz, lump, f.o.b. North Carolina.....	net ton	5.00	—	7.50
Shellac, orange fine.....	lb.	.52	—	.53
Shellac, orange superfine.....	lb.	.55	—	.56
Shellac, A. C. garnet.....	lb.	.44	—	.45
Shellac, T. N.....	lb.	.45	—	.46
Soapstone.....	ton	12.00	—	15.00
Sodium chloride.....	long ton	12.50	—	13.00
Talc, paper-making grades, f.o.b. Vermont.....	ton	11.00	—	20.00
Talc, roofing grades, f.o.b. Vermont.....	ton	8.50	—	13.00
Talc, rubber grades, f.o.b. Vermont.....	ton	11.00	—	18.00
Talc, powdered, Southern, f.o.b. cars.....	ton	10.00	—	14.00
Talc, imported.....	ton	30.00	—	40.00
Talc, California talcum powder grade.....	ton	18.00	—	40.00

## Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh.....	per ton	\$37.50-40.00	—	—
Carborundum refractory brick, 9-in.....	1,000	1250.00	—	—
Chrome brick, f.o.b. Eastern shipping points.....	net ton	60	—	—
Chrome cement, 40-45% Cr <sub>2</sub> O <sub>3</sub> .....	net ton	30-32	—	—
Chrome cement, 40-45% Cr <sub>2</sub> O <sub>3</sub> , sacks, in ear lots, f.o.b. Eastern shipping points.....	net ton	33-35	—	—
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works.....	1,000	36-40	—	—
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works.....	1,000	30-35	—	—
Magnesite brick, 9-in. straight.....	net ton	70	—	—
Magnesite brick, 9-in. arches, wedges and keys.....	net ton	77	—	—
Magnesite brick, soaps and splits.....	net ton	98	—	—
Silica brick, 9-in. sizes, f.o.b. Chicago district.....	1,000	42-45	—	—
Silica brick, 9-in. sizes, f.o.b. Birmingham district.....	1,000	46-50	—	—
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.....	1,000	35-38	—	—

## Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	\$225.00
Ferrochrome per lb. of Cr. contained, 6-8% carbon, ear lots.....	lb.	.14	—	—
Ferrochrome per lb. of Cr. contained, 4-6% carbon, ear lots.....	lb.	.15	—	—
Ferromanganese, 76-80% Mn, domestic.....	net ton	65.00	—	68.00
Ferromanganese, 76-80% Mn, English.....	net ton	65.00	—	68.00
Spiegelisen, 18-22% Mn.....	net ton	26.00	—	27.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo.....	lb.	2.50	—	—
Ferro-silicon, 10-15%.....	net ton	40.00	—	42.00
Ferro-silicon, 50%.....	net ton	65.00	—	68.00
Ferro-silicon, 75%.....	net ton	135.00	—	138.00
Ferrotungsten, 70-80%, per lb. of contained W.....	lb.	.45	—	.50
Ferroumium, 35-50% of U, per lb. of U content.....	lb.	6.00	—	—
Ferrovannadium, 30-40% per lb. of contained V.....	lb.	4.25	—	4.50

## Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content.....	net ton	\$8.00	—	\$10.00
Chrome ore, Calif. concentrates, 50% min. Cr <sub>2</sub> O <sub>3</sub> .....	unit	30	—	33
Chrome ore, 50% Cr <sub>2</sub> O <sub>3</sub> , f.o.b. Atlantic seaboard.....	unit	30	—	33
Coke, foundry, f.o.b. ovens.....	net ton	4.00	—	4.50
Coke, furnace, f.o.b. ovens.....	net ton	2.75	—	3.00
Coke, petroleum, refinery, Atlantic seaboard.....	net ton	14.00	—	15.00
Fluorspar, lump, f.o.b. mines, New Mexico.....	net ton	12.50	—	—
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines.....	net ton	20.00	—	—
Ilmenite, 52% TiO <sub>2</sub> , per lb. ore.....	lb.	.01½	—	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport.....	unit	22	—	—
Manganese ore, chemical (MnO <sub>2</sub> ).....	net ton	50.00	—	55.00
Molybdenite, 85% MoS <sub>2</sub> , per lb. of MoS <sub>2</sub> , N. Y.....	lb.	.55	—	.60
Monazite, per unit of ThO <sub>2</sub> , c.i.f. Atlantic seaport.....	unit	30.00	—	—
Pyrites, Spanish, fines, c.i.f. Atlantic seaport.....	unit	12	—	12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport.....	unit	12	—	12
Pyrites, domestic, fines, f.o.b. mines, Ga.....	unit	11	—	12
Rutile, 95% TiO <sub>2</sub> , per lb. ore.....	lb.	.15	—	—
Tungsten, scheelite, 60% WO <sub>3</sub> and over, per unit of WO <sub>3</sub> (nominal).....	unit	2.75	—	3.00
Tungsten, Wolframite, 60% WO <sub>3</sub> and over, per unit of WO <sub>3</sub> , N. Y. C.....	unit	3.00	—	3.25
Uranium ore (carnotite) per lb. of U <sub>3</sub> O <sub>8</sub> .....	lb.	1.50	—	2.50
Uranium oxide, 96% per lb. contained U <sub>3</sub> O <sub>8</sub> .....	lb.	2.25	—	2.50
Vanadium pentoxide, 99%.....	lb.	12.00	—	14.00
Vanadium ore, per lb. of V <sub>2</sub> O <sub>5</sub> contained.....	lb.	1.00	—	—
Zircon, washed, iron free.....	lb.	.03	—	—

## Non-Ferrous Metals

New York Markets

Cents per lb.

Copper, electrolytic.....	11 75@12 00
Aluminum, 98 to 99 per cent.....	24 50@25
Antimony, wholesale lots, Chinese and Japanese.....	4½
Nickel, ordinary (ingot).....	41 00
Nickel, electrolytic.....	44 00
Monel metal, spot and blanks.....	35 00
Monel metal ingots.....	38 00
Monel metal, sheet bars.....	40 00
Tin, 5-ton lots, Straits.....	26 125
Lead, New York, spot.....	4 40
Lead, E. St. Louis, spot.....	4 20@4 25
Zinc, spot, New York.....	4 55
Zinc, spot, E. St. Louis.....	4 20

## OTHER METALS

Silver (commercial).....	oz.	\$3 50½
Cadmium.....	lb.	1 00-1 25
Bismuth (500 lb. lots).....	lb.	1 50@1 55
Cobalt.....	lb.	3 00@3 25
Magnesium (f.o.b. Philadelphia).....	lb.	1 25
Platinum.....	oz.	72 00@75 00
Iridium.....	oz.	160 00@170 00
Palladium.....	oz.	53 00-55 00
Mercury.....	75 lb.	43 50-45 00

## FINISHED METAL PRODUCTS

Warehouse Price

Cents per lb.

Copper sheets, hot rolled.....	19 75@20 00
Copper bottoms.....	27 25@27 50
Copper rods.....	18 50@19 00
High brass wire.....	16 75
High brass rods.....	13 75
Low brass wire.....	18 25
Low brass rods.....	18 25
Brazed brass tubing.....	27 00
Brazed bronze tubing.....	31 75
Seamless copper tubing.....	20 00
Seamless high brass tubing.....	18 50

**OLD METALS**—The following are the dealers' purchasing prices in cents per pound:

	New York Current	Cleveland	Chicago
Copper, heavy and crucible.....	9 00@9 25	9 25	9 50
Copper, heavy and wire.....	8 25@8 50	8 50	8 50
Copper, light and bottoms.....	7 00@7 25	7 50	7 25
Lead, heavy.....	3 00@3 25	3 25	3 25
Lead, tea.....	2 25@2 35	2 25	2 25
Brass, heavy.....	4 00@4 25	4 50	5 00
Brass, light.....	3 00@3 25	3 25	3 50
No. 1 yellow brass turnings.....	3 75@4 00	4 25	4 50
Zinc.....	2 00@2 25	2 00	2 25

## Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ½ in. and larger, and plates ½ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Cleveland	Chicago
Structural shapes.....	\$2 18	\$3 00	\$3 00
8 ft steel bars.....	2 18	2 80	2 80
Soft steel bar shapes.....	2 18	2 90	2 90
Soft steel bands.....	2 50	3 20	3 20
Plates, ½ to 1 in. thick.....	2 18	3 00	3 00

\*Add 15¢ per 100 lb. for trucking to Jersey City and 10¢ for delivery in New York and Brooklyn

# Industrial

## Financial, Construction and Manufacturers' News

### Construction and Operation

#### Arkansas

EL DORADO—The Arkansas Royalty Co., Little Rock, is planning for the construction of a new gasoline-refining plant at El Dorado, with initial capacity of about 5,000 gal. per day. Lee Miles is president.

#### California

PASADENA—The Pasadena Military Academy, Oak Knoll, has preliminary plans under way for the installation of a complete chemical and scientific laboratory at the institution.

MONTEREY—R. F. Angulo, Santa Barbara, Cal., manufacturer of ceramic tile products, is planning for the construction of a new plant in the vicinity of Monterey. Clay properties suitable for tile production have been acquired in this section.

LOS ANGELES—The California Gypsum Corp., 731 Pacific Finance Bldg., is planning for the erection of a new plant at Coyote Wells, Imperial County, for the manufacture of gypsum products. The plant is estimated to cost about \$650,000 with machinery, and will consist of a crushing plant, with mining machinery, to cost approximately \$100,000; plaster mill and auxiliary buildings costing \$350,000; and railroad line construction to make connection with the San Diego & Arizona R.R., estimated to cost \$200,000. R. W. Waterman is construction engineer.

#### Connecticut

STAMFORD—The Yale & Towne Mfg. Co., manufacturer of locks, builders' hardware, etc., has commenced the installation of a new annealing department at its plant, to be used for truck bearing production and other construction. The plant, comprising an arched tunnel, will be electrically operated. A new 2-ton electric furnace has been installed for the manufacture of steel and malleable iron castings, heretofore purchased from outside sources. It is proposed to operate the furnace under 4 heats a day, or with total output of eight tons of material for the period.

#### Florida

TAMPA—The Peninsula Tire & Rubber Co. is perfecting plans for the erection of its new local plant for the manufacture of tires and other rubber products. The main building will be two-story, 100 x 300 ft., with two smaller structures, each about 60 x 60 ft. The plant will be equipped for an initial output of about 300 tires per day, and is estimated to cost approximately \$200,000. The company was incorporated recently with a capital of \$1,000,000. A. H. Van Auken is general manager.

#### Illinois

CHICAGO—The G. A. Ball Bearing Co., 3051 West Lake St., manufacturer of steel ball bearings, will take bids at once for the erection of its proposed one-story addition, 208 x 230 ft., at West Lake St., and Albany Ave., estimated to cost about \$65,000. Burrett H. Stephens, 37 West Van Buren St., is architect.

#### Indiana

INDIANA HARBOR—The Inland Steel Co. has commenced surveys of its property in Portage Township, Porter County, where recent purchases totaling about 640 acres of land have been made. The site will be used for the construction of a new steel works. No announcement has been made as to when construction will be inaugurated.

JASPER—Louis Mehninger, receiver for the Jasper Tire & Rubber Co., has arranged for the sale of the company's property.

#### Kentucky

PADUCAH—The Ohio-Kentucky Fluorspar & Lead Corp., City National Bank Bldg., recently formed with a capital of

\$1,000,000, has leased the properties of the North American Fluorspar & Lead Corp. at Smithland, Ky., and plans extensive development of the site, aggregating about 1,000 acres. A plant will be established to develop a daily production of about 100 tons of lead and fluorspar. T. J. Clay is president and F. B. Moodie, vice-president and general manager.

#### Louisiana

BASTROP—The Bastrop Pulp & Paper Co. is planning to begin operations at its new local pulp and paper mill, now in course of erection, early in October, and work is being pushed for the completion of the plant. The mill will have an initial output of about 60 tons of pulp, dry weight every twenty-four hours, and will represent an investment in excess of \$600,000. The company is affiliated with the Kansas City Packing Box Co. and the Kansas City Fiber Box Co., both of Kansas City, Mo., with L. H. Fox heading all three organizations. The entire output of the new pulp and paper mill will be utilized at the Kansas City mills.

LEESVILLE—The Louisiana Oil Refining Co. and the Caddo-Central Oil & Refining Co. will rebuild the portions of their local plants, recently damaged by fire, with loss reported at \$22,000.

#### Massachusetts

LOWELL—The Wamesit Chemical Co. recently incorporated with a capital of \$100,000, has acquired the entire plant and business of the Avery Chemical Co. and operations in the future will be conducted by the new organization. George Stevens is president, and John H. Murphy, 8 Shattuck St., treasurer.

GARDNER—Otto W. Siebert, until recently connected with the Bay State Metal Wheel Co. and the Children's Vehicle Corp., both of East Templeton, Mass., has leased the Wright property on Main St., and a building in the vicinity on Logan St., for the establishment of a new plant for the manufacture of fiber vehicles for children, and other fiber specialties. The structures will be remodeled and improved, and machinery installed at an early date. It is proposed to have the new works ready for service during the fall. At a later date, within the coming year, it is planned to construct an entirely new plant in this section for the same character of production.

#### Maryland

BALTIMORE—The American Sugar Refining Co., 117 Wall St., New York, is arranging for the operation of its new sugar mill in the Locust Point district, Baltimore, early in the coming year. Construction work is being pushed and machinery will be installed as soon as the buildings are ready. The plant will represent an investment of about \$8,000,000 and give employment to more than 2,000 operatives.

#### Michigan

NILES—The Hercules Steel Post Co., is having plans prepared for a new local plant, to be one-story, 50 x 250 ft., and estimated to cost about \$25,000. Erection will be commenced at an early date. G. J. Pammel, secretary of the local Chamber of Commerce, is handling the details of the project.

#### Minnesota

DULUTH—The Minneapolis Steel Co., a subsidiary of the United States Steel Corp., has acquired a tract of land totaling about 330 acres in the vicinity of its plant in the Morgan Park section. The acquisition gives the company control of the waterfrontage along the St. Louis River, between New Duluth and the present works. It is said that the site will be used for additions to the steel plant, with cost estimated in excess of \$5,000,000.

#### Missouri

JOPLIN—The Nichols Wire & Sheet Metal Co. Tenth and Missouri Sts., has plans under way for the erection of a 1-story works building, 50 x 200 ft., at 513 East Fifth St.

#### Montana

BUTTE—The Anaconda Copper Mining Co. is said to be planning for the erection of a new wire insulating plant at Great Falls, to be used in connection with its copper wire and rod mill here.

#### Nevada

MINA—The Mina Mercury Co. has construction under way on two new retorts at its plant to increase the output to four flasks of quicksilver daily.

#### Newfoundland

ST. JOHN'S—The A. E. Rex Co. is considering the rebuilding of its pulp mill at Bishop's Falls, destroyed by fire, July 27, with heavy loss.

#### New York

BUFFALO—The Iroquois Natural Gas Co., Iroquois Bldg., has tentative plans under way for the construction of a new artificial gas plant, estimated to cost about \$4,000,000. The proposed plant will be operated in conjunction with the company's natural gas system. Application is now before the Public Service Commission for the acquisition of the local gas properties of W. J. Judge, Buffalo Gas Co., by the Iroquois company.

#### Ohio

TOLEDO—The Spitzer Paper Box Co., 3051 Monroe St., is taking bids for the construction of a 3-story addition, 30 x 80 ft., estimated to cost about \$50,000. George B. Rheinfrank, Gardner Bldg., is architect and engineer. Lyman Spitzer is president.

TOLEDO—The Libbey Glass Co. will increase its working force by about 400 operatives, effective at once. Former employees at the plant will comprise the majority of the greater working force.

CLEVELAND—The International Steel Tire Co., 15702 Waterloo Rd., is considering tentative plans for the erection of a new plant on Waterloo Rd. It is proposed to commence construction during the coming fall. W. P. Day is president and T. J. Lavan, company address, engineer.

SHELBY—The Shelby Sales Book Co., manufacturer of paper specialties, has awarded a contract to the D. Mohler Construction Co., West First St., Mansfield, O., for the erection of a 1- and 2-story addition to its plant. Construction will be commenced at once.

#### Oklahoma

LAWTON—A. L. Lund, Lawton, and associates are planning for the immediate establishment of a new paint manufacturing plant, with initial daily output of about 1,000 gal. of material.

#### Pennsylvania

BROWNSVILLE—The Brownsville Window Glass Co. is planning for the rebuilding of its plant, destroyed by fire Aug. 6, with loss estimated at about \$300,000, including machinery. W. S. Phillips is general manager.

#### Texas

MEXIA—O. H. Foster, Breckrenridge, Tex., and associates are organizing a new company to construct and operate an oil refinery at Mexia. A tract of about fifty acres of land has been secured in the northern section of the borough, and plans are under way for a refinery to cost about \$400,000.

TEXAS CITY—The Swiftsure Petroleum Co., Houston, Tex., is planning for the construction of a new topping plant at its works at Texas City, comprising the former plant of the Bennett Petroleum Co., recently acquired. Mills Bennett is president.

#### Virginia

RICHMOND—The Richmond Pressed Metal Works are planning for the rebuilding of the portion of their plant recently destroyed by fire.

#### West Virginia

WHEELING—The Bonita Art Glass Co., recently organized with a capital of \$100,000, has plans under way for the erection of a new local plant, consisting of two buildings, each about 60 x 80 ft. George E. House is president, and Otto Jaeger, secretary-treasurer and manager.

MORGANTOWN—The United States Window Glass Co. is arranging for a resumption of operations at its local plant, known as the Seneca Works, on Aug. 25. It is proposed to develop capacity output in about a month.

## Capital Increases, etc.

THE SCOBEL-MILLER CHEMICAL CO., Rochester, N. Y., has filed notice of increase in capital from \$20,000 to \$60,000.

THE NATIONAL INDEPENDENT OIL CO., York, Pa., a Delaware corporation, has filed notice of increase in capital from \$200,000 to \$500,000.

THE COLUMBUS FOUNDRY CO., Columbus, Ind., has filed notice of increase in capital to \$25,000.

THE SOUTHERN ELECTRO STEEL CO., Lynchburg, Va., has increased its capital to \$100,000. Joseph Keyser is president.

THE IMPERIAL WALL PAPER CO., Queensbury, N. Y., manufacturer of paper products, has increased its capital from \$750,000 to \$900,000.

THE KEINER-WILLIAMS STAMPING CO., Vine St., Brooklyn, N. Y., manufacturer of stamped metal products, has filed notice of increase in capital from \$300,000 to \$500,000.

THE GIBSON-ZAHNISHNER OIL CORP., a Delaware corporation, has filed notice of organization to operate in New York, with capital of \$300,000, for the manufacture of oil products. J. F. James, 501 Fifth Ave., represents the company.

## New Companies

THE RICHDALE OIL CORP., Boston, Mass., has been incorporated with a capital of \$100,000 to manufacture oil products. William G. Todd is president; and John F. Ryan, 18 Tremont St., treasurer.

THE INDEPENDENT PAPER MILLS, INC., Brooklyn, N. Y., has been incorporated with a capital of \$50,000 to manufacture paper products. The incorporators are P. W. Horwitt, L. Laveck and D. E. Latham, 280 Broadway, New York.

THE KANE CHEMICAL CO., Chicago, Ill., has been chartered under state laws to manufacture chemicals and chemical by-products. The incorporators are J. E. S. Teal, Louis Sallinger and Charles E. Heckler, Room 1515, 111 West Monroe St.

THE REZNOIR CORP., Alden (Erie Co.), N. Y., has been incorporated with a capital of \$30,000, to manufacture molded and composition products. The incorporators are H. M. Dent, C. E. Leffel and F. J. Moore, Alden. The company is represented by A. W. Plumley, Mutual Life Bldg., Buffalo, N. Y.

THE PANHANDLE BRICK & TILE CO., Amarillo, Tex., has been incorporated with a capital of \$80,000 to manufacture brick, tile and other burned clay products. The incorporators are W. C. Pope, A. S. Stinnett and H. B. Boyle, Amarillo.

THE EXCEL ALL PUNCTURE-PROOF TUBE CO., Jersey City, N. J., has been incorporated with a capital of \$125,000 to manufacture rubber tubes for automobile tire use, and other rubber products. The incorporators are David A. Farrington, E. L. Williams and Frank G. Schafer, 673 Summit Ave.

THE PURE ALUMINUM CO. OF AMERICA, INC., New York, has been incorporated with a capital of \$100,000 to manufacture aluminum products. The incorporators are H. P. Armstrong, B. L. Shaw and E. E. Grabo. The company is represented by J. M. Coleman, 29 Broadway.

THE MATTSON WIRE & MFG. CO., Market and Lucas Sts., Joliet, Ill., has been chartered under state laws to manufacture wire and other steel products. The incorporators are Jesse A. Tune, C. N. and Elmer L. Crouch, F. A. Hill, 314 Barber Bldg., Joliet, represents the company.

THE INTERNATIONAL COTTON PROTECTING CO., Dallas, Tex., has been incorporated with a capital of \$25,000 to manufacture paste, compounds and other protective solutions for cotton service. The incorporators are S. Van deMark, and Edgar G. Macley, both of Houston, Tex.; and Charles J. Hinkley, Dallas.

H. J. STEIN & CO., INC., Boston, Mass., has been incorporated with a capital of \$25,000 to manufacture chemicals and affiliated products. Henry J. Stein, Holborn Street, Roxbury, Mass., is president and treasurer.

THE PETRONIO CHEMICAL CO., Newark, N. J., has been incorporated with a capital of \$10,000 to manufacture chemicals and chemical byproducts. The incorporators are Muzio Petroni and Frank A. Rizzolo, 810 Broad St.

THE D. & C. SPECIALTY CO., New York, N. Y., has been incorporated with a nominal

capital of \$5,000 to manufacture soaps, chemicals and affiliated products. The incorporators are D. T. Clavin, C. Curtis and M. Lieberman. The company is represented by M. E. Selling, 358 Fifth Ave.

THE IROQUOIS MFG. CO. OF PENNSYLVANIA, Scranton, Pa., has been incorporated with a capital of \$10,000 to manufacture paints, varnishes, etc. W. E. Woehrman, 6408 Euclid Ave., Cleveland, O., is treasurer.

THE COCHRANE CHEMICAL INDUSTRIES, INC., Augusta, Me., has been incorporated with a capital of \$10,000 to manufacture chemicals and chemical byproducts. E. M. Leavitt is president and treasurer; and S. L. Fogg, director, both of Augusta.

THE CULBERTSON COUNTY SULPHUR & DEVELOPMENT CO., Austin, Tex., has been incorporated with a capital of \$30,000 to manufacture sulphur products and operate properties of this and kindred character. The incorporators are J. Miles Hall, H. C. Morrow, Sr. and Jr., all of Austin.

THE GROVE CO., Philadelphia, Pa., has been incorporated with a capital of \$10,000 to manufacture chemicals and chemical byproducts. M. A. Sherman, 1220 Herbert St., Frankford, Philadelphia, is treasurer.

THE VICTOR LENS MFG. CO., Camden, N. J., has been incorporated with a capital of \$125,000 to manufacture lenses and other precision glass products. The incorporators are Clifford A. Baldwin, George D. Rothermel and Albert E. Burling, 520 Market St.

THE MARL LIME & FERTILIZER CO., 1030 Citizens' National Bank Bldg., Los Angeles, Cal., has filed notice of organization to manufacture fertilizer products. A. J. and L. E. Robinson head the company.

THE RYAN OIL CO., Spencer, W. Va., has been incorporated with a capital of \$50,000 to manufacture refined oil products. The incorporators are Thomas P. Ryan, Spencer; Charles E. and William E. Hogg, Point Pleasant, W. Va.

THE LUCINDA REFINING CO., Lucinda, Pa., has been incorporated with a capital of \$200,000 to manufacture refined oil products. J. F. Elsworth, Lucinda, is treasurer.

THE NEW ERA CONCRETE TILE CO., Camden, N. J., has been incorporated with a capital of 2,500 shares of stock, no par value, to manufacture tile, blocks and other molded products. The incorporators are Charles A. and M. M. Smith, and George C. Rogers. The company is represented by David R. Rose, 522 Market St.

THE PENN-OLEAN CO., Olean, N. Y., has been incorporated with a capital of \$50,000 to manufacture refined oil products. The incorporators are H. C. and M. G. Fleming, and G. Forbes. The company is represented by A. J. Hastings, Olean.

THE CAMARILLO-DOME OIL CO., Ocean Park, Santa Monica, Cal., has been incorporated with a capital of \$50,000 to manufacture petroleum products. The incorporators are S. H. Bailey, George L. Adams and R. R. Robbin, Santa Monica. The company is represented by Tanner, Odell & Taft, attorneys, Santa Monica.

THE CENTRAL MAINE BRICK & STONE CORP., Fairfield, Me., has been incorporated with a capital of \$50,000 to manufacture brick and other burned clay products. Desire Baker is president; and William Seltzer, treasurer, both of Fairfield.

THE CHOCTAW COTTON OIL CO., New York, N. Y., has been incorporated under Delaware laws with capital of \$1,500,000 to manufacture cottonseed oil and other vegetable oils. The company is represented by A. W. Britton, 65 Cedar St.

THE NORTH METAL & CHEMICAL CO., York, Pa., has been incorporated with a capital of \$50,000 to manufacture chemicals and other products. H. B. North, York, is treasurer.

F. SCHOFIELD, INC., New York, N. Y., has been incorporated with a capital of \$100,000 to manufacture petroleum products. The incorporators are F. Schofield, G. Reda and H. S. Leman. The company is represented by H. N. Wessel, 45 Cedar St.

THE INTERBOROUGH OIL CO., New York, N. Y., has been incorporated with a capital of \$25,000 to manufacture refined oil products. The incorporators are H. L. Schwartz, L. M. and M. Block. The company is represented by S. Brandt, 347 Fifth Ave.

THE RED RIVER OIL SHALE CO., Clay City, Ky., has been incorporated with a capital of \$250,000 to construct and operate a new oil-distillation plant in this section. J. W. Lee, Clay City, is president.

THE CO-OPERATIVE PAINT CO., 1315 Daisy Ave., Long Beach, Cal., has filed notice of organization to manufacture paints, varnishes, etc. The company is headed by E. A. Smith, W. H. McLean and George H. Evans, all of Long Beach.

## Industrial Notes

THE ANTI-HYDRO WATERPROOFING CO., New York, has developed an applied hardener or flush-on, known as Armortop, for use on old floors or floors that are laid truly monolithic. Armortop is a liquid chemical compound that is diluted with equal parts of water and is applied with a brush.

E. S. CROSBY, sales and advertising manager for the United States & Cuban Allied Works Engineering Corp., has resigned to become manager of the Eastern district of the Celite Products Co., 11 Broadway, New York City.

THE BARRETT CO. announces that since Aug. 1 its offices have been in its new building, 40 Rector St., New York City.

THE GEORGE J. HAGAN CO., Pittsburgh, Pa., has just completed the erection of a modern steel factory building adjacent to its foundry at Orrville, Ohio. This building is to be used for construction and development work on all types of furnaces and furnace equipments.

THE AMERICAN BOSCH MAGNETO CORP., Springfield, Mass., announces that Roy Davey, who has been manager of the Detroit branch, is now acting as manager of the manufacturers' trade department.

## Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its twenty-first annual meeting at St. Louis, Feb. 27 to March 2, 1922.

AMERICAN CHEMICAL SOCIETY, THE SOCIETY OF CHEMICAL INDUSTRY and the American Section of the latter society will hold a joint meeting in New York, Sept. 6 to 10.

AMERICAN GAS ASSOCIATION will hold its third annual convention in the Congress and Auditorium Hotels, Chicago, the week of Nov. 7.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Lake Placid, N. Y., Sept. 29 and 30, and Oct. 1.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its annual winter meeting at Baltimore, Md., Dec. 6 to 9. Headquarters will be at the Southern Hotel and the sessions will be held in the Engineers' Club.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its fall meeting at Wilkes-Barre, Pa., Sept. 12 to 17.

AMERICAN MINING CONGRESS AND NATIONAL EXPOSITION OF MINES AND MINING EQUIPMENT will hold its twenty-fourth annual convention in the Coliseum, Chicago, Oct. 17 to 22.

AMERICAN PEAT SOCIETY will hold its fifteenth annual convention at the Hotel Commodore, New York City, Sept. 7, 8 and 9.

AMERICAN SOCIETY FOR STEEL TREATING will hold its third annual convention and exhibition Sept. 19 to 24 at Indianapolis.

THE NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SEVENTH) will be held during the week of Sept. 12 in the Eighth Coast Artillery Armory, New York City.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer and will resume them in October.

SOCIETY OF CHEMICAL INDUSTRY (BRITISH) at the invitation of the Montreal section will hold its annual meeting in Montreal and other Canadian cities during the week of Aug. 29, 1921.

SOCIETY OF INDUSTRIAL ENGINEERS will hold its fall meeting at Springfield, Mass., Oct. 5 to 7.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY will hold its fall convention with the American Pulp and Paper Mill Superintendents' Association, at Washington, Philadelphia, Spring Grove, York, York Haven, Pa., and Wilmington, Del., Oct. 18 to 20.

The following meetings are scheduled to be held in Rumford Hall, the Chemists' Club, New York; Oct. 7—American Chemical Society, regular meeting; Oct. 14—Société de Chimie Industrielle, regular meeting; Oct. 21—Society of Chemical Industry, Grasselli Medal; Nov. 11—American Chemical Society (in charge), Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, joint meeting; Nov. 18—American Electrochemical Society, regular meeting; Dec. 2—Society of Chemical Industry, regular meeting; Dec. 9—American Chemical Society, regular meeting.